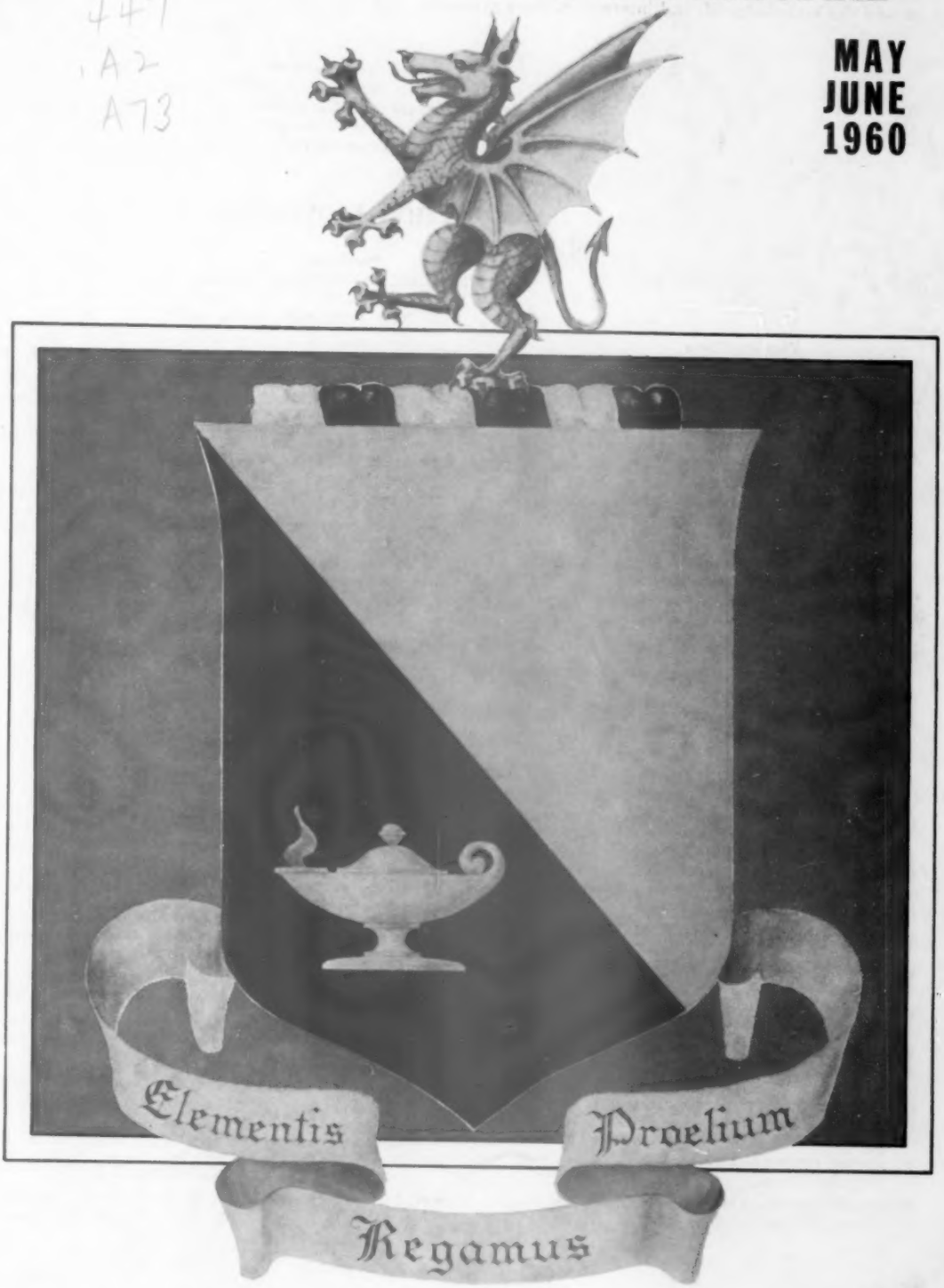
UNIVERSITY OF MICHIGAN
MAY 27 1960
CHEMISTRY LIBRARY

ARMED FORCES CHEMICAL JOURNAL

Chemistry
UG
447
.A2
A73

MAY
JUNE
1960



Librarian
University of Michigan
Ann Arbor, Michigan

ARMED FORCES CHEMICAL ASSOCIATION

National Headquarters

408-410 Park Lane Building—2025 Eye Street, N.W.

WASHINGTON 6, D.C.

(Federal 7-6823)

The members of this Association, mindful of the vital importance to national defense of chemistry, allied sciences, and the arts derived from them, have joined together as a patriotic obligation to preserve the knowledge of, and interest in, national defense problems derived from wartime experience; to extend the knowledge of, and interest in, these problems; and to promote cooperative endeavor among its members, the Armed Services, and civilian organizations in applying science to the problems confronting the military services and other defense agencies, particularly, but not exclusively in fields related to chemical warfare. (From Art. II, AFCA Constitution.)

Honorary President
MAJ. GEN. MARSHALL STUBBS
Chief Chemical Officer
Department of the Army
Washington, D.C.

NATIONAL OFFICERS

President
BRIG. GEN. CLIFFORD L. SAYRE
USAR
New York, N.Y.

Vice President
COL. ROBERT T. NORMAN
(Chairman of Finance Committee)
Washington, D.C.

Vice President
MR. HARRY A. WANSKER
(Chairman of Membership and Organization Committee)
Cambridge, Mass.

Vice President
MR. DONALD MacARTHUR
(Chairman of Meetings Committee
Washington, D.C.

Immediate Past President
MR. GLENN A. HUTT
Cleveland, Ohio

Senior Vice President
MAJ. GEN. C. E. LOUCKS, USA (Ret.)
Washington, D.C.

Vice President
DR. HAROLD C. WEBER
(Chairman of Research and Development Committee)
Milton, Mass.

Secretary-Treasurer
LT. COL. OVID E. ROBERTS, JR.
USAR (Ret.)
Silver Spring, Md.

Vice President
COL. JOHN C. MacARTHUR
USA (Ret)
(Chairman of Publications Committee)
Washington, D.C.

Vice President
LT. COL. WALTER E. SPICER, JR
(Chairman of War Mobilization Planning Committee)
Lititz, Pa.

General Counsel
MR. CHARLES E. PLEDGER, JR
Washington, D.C.

Chapter Presidents and Secretaries

CHESAPEAKE CHAPTER—Mr. George L. Cole, *Pres.*; Capt. Sampson H. Bass, Jr., *Sec.*, Army Chemical Center, Md.; Mr. R. S. Bailleul, *Treas.*, 1418 Third Road, Baltimore 20, Md.

CINCINNATI—Mr. L. Calvin Palmer, *Pres.*; Mr. W. Pilcher, *Sec.-Treas.*, 2626 Victory Parkway, Cincinnati 6, Ohio.

CLEVELAND CHAPTER—Mr. George C. Whitaker, *Pres.*; Mr. Michael Bozsin, *Sec-Treas.*, Ferro Corporation, 4150 East 56th St., Cleveland 5, Ohio.

DALLAS—Lt. Col. Herman Dorn, *Pres.*; Mr. Jack C. Jones, *Sec.-Treas.*, Room 1021, 1114 Commerce St., Dallas, Tex.

FORT DETRICK—Mr. James A. Kime, *Pres.*; Mr. Samuel Marrone, *Sec.-Treas.*, 110 Frederick Avenue, Frederick, Md.

FORT McCLELLAN CHAPTER—Col. Joseph S. Terrell, *Pres.*; Col. Douglas E. Wilson (USAR), *Sec-Treas.*, Fort McClellan, Alabama.

GEORGIA TECH STUDENT CHAPTER—Mr. Dwight B. Bronnum, *Pres.*; Mr. Jesse T. Beckham, *Sec-Treas.*, Box 4144, Georgia Tech., Atlanta 13, Ga.

MEMPHIS CHAPTER—Mr. Paul J. Traut, *Pres.*, 192 Dille Place, Memphis, Tenn.

MIDWEST—Mr. Gaillard Rumford, *Pres.*; Mr. James J. Doheny, *Sec.-Treas.*, 86 E. Randolph St., Chicago, Ill.

NEW ENGLAND—Mr. Harry A. Wansker, *Pres.*; Mr. John H. Adams, *Sec.*, 30 Memorial Drive, Cambridge, Mass.; Mr. Chenery Salmon, *Treas.*, Coffin & Burr, Inc., 60 State St., Boston 9, Mass.

NEW YORK—Mr. James Sheridan, *Pres.*; Mr. Joel Henry, *Sec.-Treas.*, 210 East 47th St., New York 17, N. Y.

PINE BLUFF ARSENAL—Mr. Conrad J. B. Hardy, *Pres.*; Mr. Edward Woodford, *Sec.-Treas.*, 2200 S. Harrison St., Little Rock, Ark.

PITTSBURGH—Mr. Fred C. Hickey, *Pres.*; Dr. Charles A. Kiernan, *Sec.-Treas.*, 1524 Pennock Road, Pittsburgh, Pa.

ROCKY MOUNTAIN ARSENAL—Col. William J. Allen, Jr., *Pres.*; Major Joseph K. Paull, *Sec-Treas.*, Rocky Mountain Arsenal, Denver 30, Colo.

SOUTHERN CALIFORNIA—Col. Samuel P. Pickett, *Pres.*; Maj. Thomas J. McEniry, *Sec.-Treas.*, 573 La Paz Drive, San Marino, Calif.

WASHINGTON, D. C.—Mr. S. A. Mattison, *Pres.*; Mr. Carroll W. Hayes, *Sec.-Treas.*, Celanese Corp. of America, 1026 17th St., N.W., Washington, D.C.

WILMINGTON—Dr. W. G. Kinsinger, *Pres.*; Dr. William J. Taylor, Jr., *Sec.-Treas.*, Atlas Powder Co., Wilmington, Del.

Armed Forces CHEMICAL JOURNAL

OFFICIAL PUBLICATION OF THE ARMED FORCES CHEMICAL ASSOCIATION

SUITES 408-410, 2025 EYE STREET, N.W., WASHINGTON 6, D.C.

VOLUME XIV | MAY-JUNE | NUMBER 3

POLICY

The fact that an article appears in this magazine does not indicate approval of the views expressed in it by any one other than the author. It is our policy to print articles on subjects of interest in order to stimulate thought and promote discussion; this regardless of the fact that some or all of the opinions advanced may be at variance with those held by the Armed Forces Chemical Association, National Officers, and the Editors. It is the responsibility of contributors, including advertisers, to obtain security clearance, as appropriate, of matter submitted for publication. Such clearance does not necessarily indicate indorsement of the material for factual accuracy or opinion by the clearing agency.

Editor
COL. JOHN C. MacARTHUR
U.S.A.-(Ret.)

Advertising Director
LT. COL. O. E. ROBERTS, JR.
USAR-(Ret.)

FRONT COVER

The Army has long applied the principles and techniques of heraldry in providing distinctive insignia for its various units and agencies. This design was approved 1 May 1934 for the Chemical Warfare School, then located at Edgewood Arsenal, Maryland. It was redesignated 27 May 1953 for the Chemical Corps School, Fort McClellan, Alabama.

The shield of yellow and blue, the colors of the Corps, contains the lamp of knowledge representing the School.

The crest, a legendary dragon, symbolizes fire and destruction, and the Latin motto is translated as, "Let us rule the battle by means of the elements."

PHOTO CREDITS

All U.S. Army, except as follows: Page 4 (upper) by Lt. Col. John F. Carroll; (lower) source not indicated; page 7, N.Y. City Civil Defense Photo Unit; page 24 Johns Hopkins U; pages 12 and 13 source not indicated.

INDEX

Page

A.F.C.A. Affairs 2
15th Annual Meeting Committee Named; Expression of Appreciation by Editor; Chapter Items

ACS Symposium on Non-Military Defense—a report of the speeches by General Stubbs, Dr. Summerson and Dr. Fothergill 6

Chemical Corps School Faces Another Decade, The
By Colonel William H. Greene 12

Defense Chemistry in the News.....*By* William T. Read, Sr. 20

Group and Sustaining Members 37

Incentives and Limitations in Use of Intellectual Property
By Harold S. Meyer 16

New Honor for Dr. Gibson 24

Nuclear Energy Industrial Wastes— (condensation of paper)
By Joseph A. Lieberman 30

"Off the Rocker" and "On the Floor"—
By Dr. Lindsey, Dr. Sim and Dr. McNamara 8

Self-Exposure to Psycho-Chemicals 10

What's Going On There?—(condensation of an article from *Army Information Digest* on Combat Surveillance by Brig. Gen. Thames) 26

With the Chemical Corps—Items 38

ADVERTISERS

Allied Chemical Corp. 25
Columbia-Southern Chemical Corp.. iv
Delta Chemical Works, Inc. 29
Diamond Alkali Company 15
Dow Chemical Co., The 3
Food Machinery & Chemical Corp. 19
General Tire & Rubber Co., The.. iii
Harshaw Chemical Co., The 7
Hooker Chemical Corp. 33
Kuhn, H. A., Consultant 4
Lummus Company, The 23
Mine Safety Appliances Co. 11
Union Carbide Chemicals Co. 5

Published bi-monthly—Jan.-Feb.; Mar.-Apr.; May-June; July-Aug.; Sept.-Oct.; Nov.-Dec.—by the Armed Forces Chemical Association, National Headquarters, located at Suite 408, 2025 Eye St., N.W., Washington 6, D.C. Entered as second class matter at the Post Office at Washington, D.C., under the Act of March 3, 1879. Additional entry at Nashville, Tenn. Subscription price $3.00 per year to members; $6.00 per year to non-members in the United States, Canada and Mexico; elsewhere $1.00 additional for postage. Inquiries concerning circulation and advertising should be addressed to the Secretary-Treasurer.

A.F.C.A. AFFAIRS

15TH ANNUAL MEETING COMMITTEES ANNOUNCED

Plans for the next annual meeting of the Armed Forces Chemical Association, at Sheraton-Park Hotel, Washington, D.C., September 15 and 16, are already beginning to take shape.

A tentative list of topics to be discussed during the two-day session has been prepared. It covers a wide spectrum of current military, scientific and industrial interests with considerable accent on current missile programs. Already initiated also is the preparation of invitations and explanatory data concerning the meeting with a view to assuring assistance and participation of the Armed Forces.

The Chairman of the General Committee for the meeting, which will be the fifteenth since the Association was organized in 1946, is Rear Admiral M. P. Hottel, USN Retired, Washington representative of the National Lead Company.

Admiral Hottel has announced the following sub-committee chairmen, all of whom are likewise representatives of their respective companies in the Nation's Capital:

Program—Mr. L. D. Weiford, Stauffer Chemical Co.

Arrangements—Mr. C. W. Hayes, Celanese Corp. of America

Publicity—Dr. G. P. Vincent, Olin Mathieson Chemical Corp.

Printing, Programs and Advertising—Mr. S. A. Mattison, Hooker Chemical Corp.

Exhibits—Mr. M. Marcus, The Lummus Company

A recent news release issued by the Publicity Committee states in part:

"This Association is dedicated to support defense efforts in scientific and technological fields with special emphasis on those related to the chemical industry. The membership of the Association includes a broad cross-section of the chemical and its allied industries, defense agencies, civilian research institutions, and both active and retired military personnel."

MIDWEST MEETING IS TIMED WITH MILITARY-INDUSTRIAL CONFERENCE

Midwest Chapter of A.F.C.A. held its business meeting and banquet in the Old Chicago Room of the Hotel Sherman, Chicago, on the evening of April 25. The title for the banquet address, which it was expected would be delivered by the Chief Chemical Officer, or other general officer of the Army Chemical Corps, was "Salute to the Technical Services."

Midwest purposely arranged the timing of the meeting so that members could take advantage of the 6th National Military Industrial Conference, held in Chicago April 25-26-27. Midwest Chapter was one of the sponsors and cooperating agencies contributing to the support of the conference.

The conference theme this year was "The U.S. Economy in a World of Conflict" and provided sessions which included outstanding representatives of industry and officers of high rank of all the Armed Services.

Election of officers of the Midwest Chapter for the forthcoming year was also scheduled for the meeting.

THE EDITOR'S THANKS

As previously announced, my editorship of the Armed Forces Chemical Journal will terminate following publication of this issue.

My successor will be announced at early date.

I take this occasion to express my appreciation and thanks to the directors, officers and general membership of A.F.C.A. for their goodwill and assistance during my seven years as Editor, and to extend to all, my best wishes for the continued progress and achievement of the Association. I am especially grateful to all those who, as authors or in editorial or other supporting capacities, have so capably contributed to the columns of the magazine.

The importance of the printer's role in producing any periodical is well-known, and I am pleased to note here the consistent cooperation and efficient service through the years (antedating my editorship) rendered to THE JOURNAL by our printers, the Benson Printing Company, Nashville, Tennessee.

JOHN C. MAC ARTHUR, *Editor*

ELECTION OF NEW PRESIDENT ON AGENDA FOR DIRECTORS

The annual spring meeting of the Board of Directors of A.F.C.A. will be held in Washington, D.C. on June 13 following the annual election by mail of twenty directors-at-large for the ensuing fiscal year.

The business to be transacted includes the annual election of officers of the Association. Mandatory this year is the selection of a new President, since the present incumbent, Brig. General Clifford L. Sayre, will have completed two terms in office.

Individual notices of the meeting are to be sent to members of the Board by National Headquarters.

MR. GLIDDEN SPEAKS TO DETROIT RESERVE GROUP ON GAS MASKS

Mr. G. M. Glidden, of the Acme Protection Equipment Company, South Haven, Michigan, a Director-at-Large of A.F.C.A., spoke on "The Gas Mask" at a regular drill meeting of the 5001 Research and Development Sub Group, USAR, Detroit, Michigan, on February 4, 1960. Lt. Colonel M. de K. T. Kennedy is commanding officer of the unit.

Mr. Glidden's talk was very well received.

CHESAPEAKE CHAPTER HEARS MR. S. W. SCHMITT OF DuPONT

Mr. Stanley W. Schmitt, of E. I. du Pont de Nemours and Company, addressed the Chesapeake Chapter of the Armed Forces Chemical Association in Baltimore on March 23, at a dinner meeting held at Gannon's Restaurant. Before the dinner the Chapter members toured the paint manufacturing facilities of the H. B. Davis Company.

DOW

Basic in over **700** chemical products

Industrial Chemicals
Agricultural Chemicals
Plastics
Magnesium

DOW

THE DOW CHEMICAL COMPANY
Midland, Michigan

N. Y. CHEMICAL OFFICERS HONOR GENERAL SAYRE

The picture above, showing A.F.C.A. President, Brig. General Clifford L. Sayre, receiving a plaque from Chemical officers in the New York area during a dinner in his honor at Governors Island, New York, is made from a photograph taken by Lt. Colonel John F. Carroll, USAR, a member of the New York Reserve group.

Due to an extraordinary combination of circumstances in the mounting of type on the presses for printing of the March-April issue, this picture, which should have been placed on page-4 with an item about the honor to General Sayre, was mistakenly placed on page-29, and a cut of the same size which belonged on page-29 was erroneously placed on page-4. THE JOURNAL regrets this error.

The group in the picture above are: (l. to r.) Col. Leonard Miller, Commanding Officer, N.Y. Chemical Procurement District; Col. Claude Merrill, Personnel Officer, Office Chief Chemical Officer, Washington, D.C.; General Sayre; Col. Frank McGuane, Commanding Officer, Chemical Corps Troop Units, First Army Area, and Col. Theodore P. Gahan, Chemical Officer, First Army (who made the presentation).

COL. DELMORE ADDRESSES GEORGIA TECH CHAPTER

In a speech at the Officers Club at Fort McPherson, Georgia, on 1 March 1960, Colonel Fred J. Delmore, commanding officer of the U.S. Army Chemical Corps Research and Development Command, likened a general of the Army using all types of warfare to a coach of a good football team such as Georgia Tech using a variety of plays.

Chapter President Bronnum greets Col Delmore.

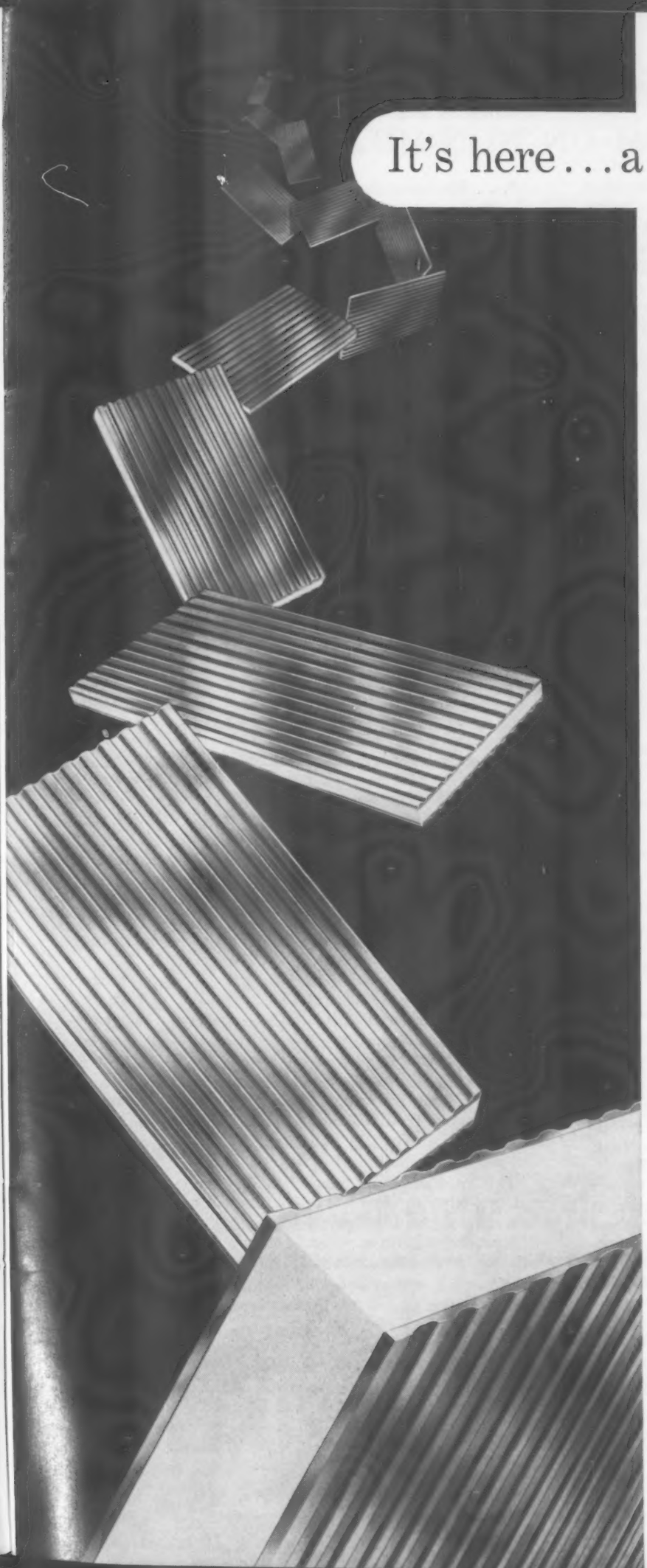
Colonel Delmore was introduced by Mr. Dwight Bronnum of Atlanta, president of the chapter whose nominee last year, Miss Annie Sue Brown, won the outstanding Science Teacher Award of A.F.C.A. This chapter is made up almost entirely of students at Georgia Tech.

Colonel Delmore congratulated the chapter on its spirit, and then told the annual dinner meeting that "It is now possible, for the first time, to develop chemical and biological weapons in a wide variety, suitable for use in many military situations. Without any other knowledge, for our own protection, we should assume that this is being done by some other nation or several nations. . ."

In concluding his speech, Colonel Delmore challenged "Many of you are students today—tomorrow you may be directing your knowledge and skills toward the solution of problems facing us in chemical and biological warfare. I hope you will look on these tasks as a challenge; I know we will welcome the new ideas you may contribute to our work."

H. A. KUHN
Consultant
Chemical & Industrial
Reports • Surveys
1426 G Street N.W.
Washington 5, D. C.

P-59-0145-A



It's here . . . a new NIAX polyether . . . for lower cost rigid foams

Improved humid aging characteristics and reduced water absorption for rigid urethane foams are advantages you obtain by using a new CARBIDE polyether—NIAX Triol LK-380. Developed by CARBIDE's research program on urethane intermediates, LK-380 produces a rigid urethane, lower in cost than polyester-based urethanes.

Wherever a low-density, foamed-in-place urethane polymer is required, LK-380 should be evaluated. It can be used in partial pre-polymer or one-shot systems. Applications for LK-380-based urethanes include insulation for refrigerators and freezers; acoustical tiles; fabrication of sandwich partitions for construction, non-sinkable boats, life buoys and deck guards.

Triol LK-380, like CARBIDE's other NIAX diols and triols, is made to rigid specifications, offering you custom control of urethane properties. They can help improve your flexible, semi-rigid, or rigid foams, elastomers, coatings, and adhesives. Order by tank car, tank truck, or in 55-gallon drums in carload or LCL lots. Remember, you save money on combination shipments in compartment tank cars and tank wagons.

Get specifications and other technical data on NIAX Triol LK-380 and other NIAX polyols from a Technical Representative in any CARBIDE office. Or write Dept. H, Union Carbide Chemicals Company, Division of Union Carbide Corporation, 270 Park Ave., New York 17, N.Y.

NIAX and UNION CARBIDE are registered trade marks.

UNION CARBIDE CHEMICALS COMPANY

UNION CARBIDE

IMPRESSIVE DISCUSSIONS OF CW AND BW DANGERS MARK ACS SYMPOSIUM ON NON-MILITARY DEFENSE

A SYMPOSIUM on the potential dangers of chemical and biological warfare to this country, emphasizing new developments in these fields and stressing civilian defense preparedness requirements, was conducted by the American Chemical Society at its 137th National Meeting, held in Cleveland, Ohio, on April 8, 1960. Entitled "Symposium on Non-Military Defense—Chemical and Biological Defenses in Perspective," the program which included impressive presentations by Major General Marshall Stubbs, Chief Chemical Officer of the Army, and two of his top civilian assistants, was given considerable attention by the press. Dr. Conrad E. Ronneberg, of Dennison University, Granville Ohio, presided at the symposium which consisted of 12 presentations. The program called for a summation by Dr. Clifford F. Rassweiler, former president of the Society.

General Stubbs spoke on the subject "This is the New CBR* Perspective." The other Chemical Corps speakers were William H. Summerson, Ph.D., Deputy Commander for Scientific Activities, CmlC Research and Development Command, Washington, D.C., whose paper was entitled "This is the CW Threat." and LeRoy D. Fothergill. M.D., of the Biological Warfare Laboratories, Fort Detrick, Frederick, Maryland, who spoke on "This is the BW Threat."

General Stubbs emphasized the greatly increased potency of the chemical arm since first used in modern warfare in World War I. He told of extensive developments and preparations in this field by the USSR; noted currently increased public attention to this subject in this country, but warned of the need for still more awareness by the people, and for stepping up our defense measures.

At the outset of his presentation, General Stubbs voiced praise of the American Chemical Society and particularly its Committee on Civilian Defense for their activities toward promoting public interest in and discussion of the threat of chemical and biological weapons. He said that he hoped that the symposium itself "will lay the groundwork for strong affirmative actions so that our nation may be prepared should the threat of warfare become an actuality . . .

". . . No single weapon, no single service, no single strategy can insure our security. The defense of our country requires the unified efforts of everyone. These efforts must be directed to all means that an enemy might use against us . . .

"To achieve effective national defense, we are becoming more and more dependent upon the increasing contributions of science and technology. While we have never discarded any weapon that has proved effective, we cannot rely on any one weapons system alone. I will not minimize the destructive power of nuclear weapons, but I will remind you that in the past there have been other weapons as revolutionary and carrying as great an impact on their respective wars. The long-bow ,the catapult, and the smooth-bore musket all had their day. They were termed horrible weapons of destruction at the time they came into being, but nevertheless had far reaching effects on the course of wars. They did not, however, make man obsolescent. Man is the ultimate weapon, and we must evaluate each new system as it affects him. . . .

". . . We are right now in a period of development of other weapons which would not carry with them the threat of total destruction. . . .

"Rapid scientific and technological advances in the field of chemical and biological defense have been made. Many of the chemical agents that were used in World War I are now obsolete, and weapons of greater range and effect have been developed.

"Ever since the last use of chemicals in World War I, too little thought has been given to the possibility that they might be used against us in some future war. I am happy to say that this situation now seems to be improving to some extent. There are many who are beginning to realize that the Free World nations do not have a monopoly on chemical and biological weapons. There is some evidence that the communist bloc may surpass us in this field. . . ."

Among recent noteworthy developments indicating increased public interest in CBR cited by General Stubbs were the hearings and report on CBR by the Science and Astronautics Committe of the House of Representatives; the resolution adopted last October by the American Legion, advocating a U.S. capability in CBR which would deter or defeat any CBR aggression; publication last October of the National Biological and Chemical Warfare Defense Plan of the Office of Civil and Defense Mobilization, and also the publication by the Department of Health, Education and Welfare of three Emergency Manual Guides for Readiness and Planning. He further noted the increasing amount of constructive information on the chemical and biological threat in newspapers and magazines.

Speaking of Soviet activities in the CBR field, he said, in part—

". . . The Soviets are not bound by any treaty or other international agreement from using these agents against us. . . .

"The Soviets over a number of years have conducted an intensive program of chemical and biological research and development. . . .

"Chemical troops are assigned at all echelons down to battalion. In general, training throughout the Soviet Armed Forces is comprehensive, intensive, and extremely realistic. Troops are given actual field experience through the use of shells containing 'live' chemical agents.

"Soviet chemical weapons are modern and effective and probably include all types of chemical munitions known to the West, in addition to several dissemination devices peculiar to the Soviets . . .

"The knowledge we have of Soviet interest, activity and capability in chemical and biological weapons must be a spur to us to be prepared against their use. This will require intensive effort, not only by the military but by our scientists and engineers as well . . ."

Continuing, with respect to the dangers of biological warfare and civil defense needs, General Stubbs stated, in part—

"The covert as well as the overt use of biological agents against us is of great concern to the Chemical Corps . . . and my great concern is that an enemy might, by careful selection and mutation, be able to develop organisms with high disease-producing pow-

(Continued on page 9)

* CBR is short term for Chemical, Biological and Radiological warfare.—Ed.

NEW TEAR GAS DEVELOPED

Development of an improved tear gas, so effective that those who have tested it are rarely willing to try it twice, was announced on March 8, 1960 by the Department of the Army.

The gas, not yet given a name, causes no permanent injury and its effects wear off quickly in the fresh air, the announcement stated.

Although discovered by two Americans, the British have been leaders in the development of the new gas. The United States Army has conducted tests to determine its toxicity, and also has developed means for dissemination.

UP TO 2-WEEKS STAY IN A FALLOUT SHELTER PLANNED

An experimental fallout shelter is being equipped in Pittsburgh to test the behavior of men, women and children under a possible nuclear attack.

The tests will be conducted for the Office of Civil and Defense Mobilization by the American Institute for Research.

The intention, the Office of Civil and Defense Mobilization states, is to recruit groups of people such as would be brought into a public shelter at random by a real attack warning. Successive test groups numbering up to 30 will be asked to eat, sleep and live in the experimental shelter during periods ranging from a weekend for the first groups to as much as two weeks or more for the final groups. Previous wartime observations give little indication of the effect of such close shelter confinement on the behavior of the occupants or on the problems of shelter management.

The shelter will contain facilities to survive nuclear fallout, but, since these are tests of behavior rather than of shelter protection, no nuclear radiation will be involved.

The OCDM notice states further that the men, women and children to be studied in the shelter will be tested in advance for their mental, physical and social characteristics that may be expected to affect shelter behavior, and that during their stay in the shelter, their behavior will be closely observed.

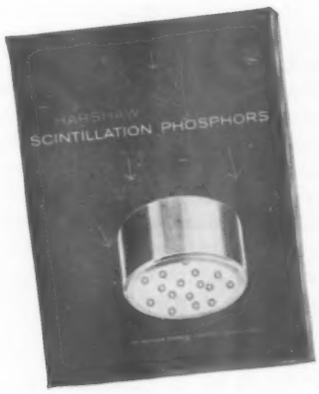
COL. ANUSKEWICZ IS CHEMICAL CHIEF FOR NYC CIVIL DEFENSE

Colonel Benjamin T. Anuskewicz, U.S. Army (Ret.), has been appointed Chief of the Chemical and Biological Services of the New York City Civil Defense Agency. He is shown in picture herewith, taken when oath of office was administered.

Colonel Anuskewicz whose military service dates back to 1916 when he enlisted in the Cavalry for service in Mexico has, since World War I, held various chemical warfare assignments. In World War II he was wounded twice in action against the enemy during D Day operations and was retired for combat disabilities in 1946.

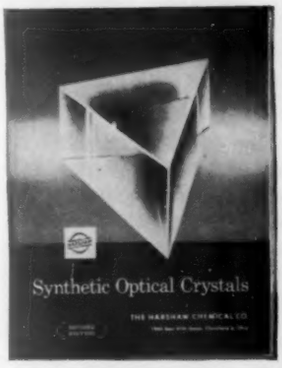
Colonel Anuskewicz has been active in Civil Defense since 1950. He is making his services available to New York City on a voluntary basis and has been assigned an office in New York City Civil Defense Headquarters, 135 East 55th Street, Manhattan.

WRITE FOR THESE FREE BOOKS



HARSHAW SCINTILLATION PHOSPHORS

THIS 40 PAGE BOOK presents definitive article on characteristics and properties of scintillation phosphors with special emphasis on NaI(Tl). A general discussion of scintillation counting is augmented with many appropriate tables, efficiency curves, and typical gamma ray spectra. Gives specifications and drawings of Harshaw mounted phosphors, and lists miscellaneous other phosphors available from Harshaw. We will be pleased to send you a copy.



HARSHAW SYNTHETIC OPTICAL CRYSTALS

THIS 36 PAGE BOOK discusses in detail various Harshaw crystals used for infra-red and ultra-violet optics. Includes many pertinent graphs. Ask for your copy today.

HARSHAW

THE HARSHAW CHEMICAL COMPANY

1945 EAST 97th STREET • CLEVELAND 6, OHIO

CHICAGO • CINCINNATI • CLEVELAND • DETROIT • HOUSTON • LOS ANGELES • PHILADELPHIA
HASTINGS-ON-HUDSON, N. Y. • PITTSBURGH

"OFF THE ROCKER" AND "ON THE FLOOR"

NON-LETHAL CHEMICAL AGENTS

By

Douglas Lindsey, M.D., Van M. Sim, M.D., and Bernard P. McNamara, Ph.D.

Directorate of Medical Research
U.S. Army Chemical Warfare Laboratories
Army Chemical Center, Maryland

THERE HAS BEEN much to read lately, in journals ranging between *Mechanix Illustrated* and *Harper's*, about chemical weapons—both agents with new or increased killing power, and agents which do *not* kill, but which produce some type of incapacitation short of death. Many of the agents of the latter type produce a sort of temporary mental derangement. Perhaps this is the stimulus to the occasional question: "Are the chemical warfare people off their own rocker? Why fool around with agents which do *not* kill, if better and better lethal agents are still coming along?"

One possible explanation is to be gleaned from reporters' headlines: "War Without Death," and "Mercy Mist." War is still a messy business, and probably always will be, but certainly it would be a distinct boon to mankind if wars *could* be fought and decided with non-lethal weapons. However, there are more prosaic answers to the question of *why* non-lethal agents. Some of these answers are coldly logical enough that we may fairly impute them to a potential enemy who may be bound by no considerations of humanity whatsoever. There are good reasons why both the United States and its potential enemies should be working on non-lethal chemical agents.

Nuclear weapons are unquestionably destructive weapons. They provide a quick means of subtracting from the assets of one's enemies. With a few well-placed thermonuclear weapons an enemy could destroy the bulk of our steel industry, and it is conceivable that such an enemy might win a war against us. He would then surely emerge as a *relatively* stronger power, but not as an absolutely stronger power. In compensation for the damage that he has suffered in retaliation, there would be not too much left here for him to haul away as "reparations."

The same principle holds for us, in slightly different form. We are not accustomed to exacting reparations, but rather the reverse. If we are forced into war, and if we must win it by destroying the cities and the industry of the enemy, we will face, in addition to the problems of restoring our own country, a staggering post-war burden in feeding, sheltering, and rehabilitating the defeated.

On the other hand, lethal chemical agents are destructive of personnel only, not materiel. If an enemy defeats us by using lethal chemical weapons, our mills and assembly lines will still be intact, and subject to dismantling, transfer to the enemy's homeland, and restaffing with his own workers—a substantial improvement over the wreckage he would inherit if he used nuclear weapons.

Non-lethal chemical agents go even further than this. If an enemy should defeat a country by chemically inducing an incapacity of will or ability to fight, he then gains both personnel and materiel resources. He can haul away plants and workers, or leave them *in site*, but operating under the regime he imposes on the population.

It is naive to assume that wars will be fought entirely with chemical weapons, lethal or non-lethal. But to whatever extent they *are* used, they offer this selectivity, and decrease in destruction.

There are special uses too for non-lethal weapons. If we must fight a "limited" war when the territory of the battlefield includes both an opposing military force, and a friendly (or neutral) civilian population, we will wish to minimize the suffering of our friends. Non-lethal agents may be part of the answer to this problem.

Once the concept of non-lethal incapacitating agents is accepted, a wide door is open to a variety of means of effecting incapacitation. To simplify the essential functions of a soldier, he must be able to: think, see, move, and shoot (or manipulate his primary tool of war, if this be not a gun). It is highly desirable, but probably not essential, that he be able to hear; other sensory functions are of even lesser importance. The essential functions of the civilian worker are roughly comparable.

To date, the greatest publicity on incapacitating agents has been given to agents which affect the broadly-defined function "to think." This is the "off the rocker" class as opposed to "on the floor" agents. It has been tagged with a number of scientific terms, none of which is both fully-inclusive and wholly accurate. These terms are used interchangeably, but they are not properly interchangeable.

Psychotomimetic drugs are those which induce a temporary state mimicking one of the psychoses or states of insanity, such as schizophrenia. *Psychotropic* drugs are those which have a tropism or affinity for the mind; included are such diverse effects as tranquilization, stimulation, and aberrations of thinking. Psychochemical is a looser term, but with essentially the same meaning as psychotropic.

Thus, not all agents which act by mental incapacitation are "psychotomimetic," nor do all "psychotropic" drugs produce incapacitation. In fact, it is conceivable that certain psychotropic drugs could be used to *improve* the performance of one's own troops.

Although the distinction between "mental" and "physical" incapacitation is not always clear, interruptions of ability to see, move, and shoot are conveniently grouped in the latter class.

Vision can be blocked by optical means, such as clouding the cornea. Or it can be blocked by non-optical means through interference with the complex nervous pathways involved in the visual process. The eyes still function but the man does not *see*.

To cloud the cornea is no problem. The trick is to

produce a temporary, fully reversible, clouding. To produce permanent blindness would be uncondonable cruelty, offering no advantage over lethal weapons of any type. To produce temporary, non-optical blindness is even trickier, but the potential value makes it well-worth an intensive research effort.

Ways are legion to block ability to move about, but the choice is more limited if one desires to block only the ability to shoot, and thus to produce an enemy who is militarily impotent, but still able to march off on order after he has been disarmed.

A man is rendered effectively immobile if he is unable to maintain balance and sense of position. He is nearly immobilized if his blood pressure is abruptly so lowered that he faints as soon as he rises to a standing position; he is immobilized if he is anesthetized, or paralyzed. Either way, he is truly "on the floor." He is immobilized if he is "frozen" in position by rigidity of muscles which he cannot relax. All of these are attainable pharmacological effects.

There are other effects of considerable promise—more subtle and perhaps more complex; more specialized, to fit a particular situation; long-acting, for strategic use.

The choice of "off the rocker," versus "on the floor" is clouded about with a great number of pros and cons on each side. Indeed, as we have implied, the distinction itself may be an entirely artificial one. At any rate, non-lethal agents, of one type or another, are a coming thing, and they will undoubtedly find secure places in the world's arsenals of weapons.

ACS SYMPOSIUM

(Continued from page 6)

ers which could overcome vaccines and antibiotics . . .

"Non-military or civil defense programs can play a key role in preventing a 'cold war' from becoming a 'hot war.' . .

"Preparation for non-military chemical and biological defense is and must be a part of our preparation to meet an attack, to win, and to recover . . .

"The nations of the Free World must also bring into proper perspective the threat which they face from the possible use of chemical and biological weapons. In most instances, because of their geographical proximity, they are even more vulnerable than we. There should be Free World preparedness comparable to United States preparedness. This can be effectively assisted by exchange of scientific and technological information among the free nations . . ."

Dr. Summerson's Address

Dr. Summerson in his presentation first stressed the seriousness in modern concepts of warfare of the nerve gas threat. Referring to discovery of nerve gas by the German chemist Schrader in 1939, a development which he stated did not become known until after World War II was over, he continued, in part—

"The term 'nerve gas' refers to a group of highly toxic chemical compounds, which are generally organic esters of substituted phosphoric acids . . .

"The compound known as Tabun is the nerve gas which the Germans had available in quantity during the closing years of World War II . . .

"The second of the two nerve gases . . . Sarin, which is known to us as 'GB' was not available to the Germans in quantity during World War II . . . It has been exhaustively investigated with respect to its possible effects on the battlefield.

"The nerve gases introduced several new elements into the war gas picture. The first of these was a significant increase in lethality over previously known chemical agents. This increase in lethality is at least one order of magnitude or more over that of previously known chemical agents. With such an increase in potency available, it became possible for the first time to consider seriously the dissemination of chemical agents in other than local tactical situations, i.e., delivery by aircraft or missiles at long range. Such long range delivery of toxic chemical weapons must now be considered to be a real threat, one which did not exist prior to the discovery of the nerve gases. Furthermore, this threat may well increase in intensity as even more potent chemical weapons are discovered, as they most surely will be with continued research in this field. It is surely sobering to realize that any major military power can manufacture GB or a comparable material at the rate of hundreds of tons per day. GB is a liquid, but a volatile liquid. When disseminated as a military agent, it will usually appear in a vapor form—a true 'gas.' The major portal of entry is inhalation. It can also enter by contact with the eyes. Consequently, an effective mask offers essentially complete protection. So long, however, as the civilian population is not possessed of individual masks and the training to use them, GB poses a major threat. A single large enemy missile could disperse enough GB to produce 33% casualties among all unmasked personnel in the open over an area one mile in diameter. A one mile circle over a metropolitan target would encompass many thousands of people . . .

". . . we cannot afford to ignore the real possibility that even more powerful chemical weapons than the nerve gases remain to be discovered. There are many toxic substances known today which are more lethal on a weight basis than any of the nerve gases. Some of these substances can be made in the laboratory. Others can be found in nature . . ."

Dr. Summerson next discussed in some detail recent developments and military possibilities of non-lethal chemical compounds to cause temporary incapacitation.

In concluding he said—

". . . To meet the CW threat, it is imperative that all elements of our population be aware of the existence and magnitude of this threat, and be alert and responsive to the erection of means for defense against this threat. Such means include an active civil defense organization, readily available means for use in defense against chemical agents, and support of a vigorous research and development program on chemical agents to provide for the continuing awareness of new elements of danger in this important weapons area, thus to be better prepared than we are now for the use of chemical weapons against us."

Dr. Fothergill Discusses BW Danger

At the outset of his presentation Dr. Fothergill said—

"The threat of biological warfare is very real. The potentialities of this threat for every community in our land must be examined in detail and with dedicated seriousness. The greatest threat may not lie in its capacity to kill people, but rather in the destruction of the economy through the incapacitation of the working force and the reduction of crops and domestic animals.

"Biological warfare is primarily a strategic weapon for two major reasons: First, it has no quick-kill effect.

(Continued on page 27)

SELF-EXPOSURE TO PSYCHOCHEMICALS

(Interesting article from Army Chemical Center tells of the work of Dr. Van M. Sim, chief clinical research division, Chemical Warfare Laboratories, in testing program using human volunteers.)

ARMY CHEMICAL CENTER, MD.—As a small group of white-coated Army doctors silently looked on here not long ago, Dr. Van M. Sim mixed a milligram of a white crystalline material into a glass of water and drank the concoction down.

For Dr. Sim, chief of the Chemical Warfare Laboratories' clinical research division, it was a familiar role —that of the Chemical Corps' most experienced human test subject.

Chief research physician for the Corps' human volunteer program, Dr. Sim subjects himself to new and untried chemical warfare agents before testing them on other volunteers.

This particular test sample, resembling a pinch of table salt, was a synthesized version of a chemical extracted from a species of mushroom to which Mexican Indians for centuries have attributed magical powers. Indian mystics still chew the mushrooms during religious rites in order to "contact" the deities or the dead.

Known to cause hallucinations in humans, the chemical has recently been used in the treatment of the mentally ill. But as has been so often the case, Dr. Sim was one of the first normal humans to be subjected to the pure material.

In the minutes and hours after imbibing the mushroom cocktail, the Army researcher found himself in a bizarre new world. He remained conscious and rational throughout, describing his sensations in precise and vivid detail.

After an hour of pacing the floor and bantering with his colleagues, Dr. Sim held out a slightly trembling, prespiring hand. "Not too steady, is it?" he joked, and observed the angry red, mottled appearance of his palms. "Very interesting," he murmured thoughtfully. "This is something new for me."

Twenty minutes later he interrupted a conversation with a visitor to exclaim, almost triumphantly, "I'm hallucinating right now. You don't know it, but you just turned a sickly shade of green."

He strode nervously back and forth in the sparsely furnished hospital-like ward as assistants and fellow researchers gathered to watch. "What number cloud should I meet you on tonight?" he cracked, to nobody in particular.

"I'm feeling now just like you do after a dose of sodium pentathol or chlorofrom, just before they wheel you down the hall. I feel very light, almost weightless —and for me, that's quite a trick," grinned the portly doctor drily.

A few hours later, the drug began to wear off and Dr. Sim soon was completely over the effects.

Why is he willing to take the risk of exposure to these new drugs?

"Because I think it's important," he explains quietly. "It's imperative that we have a knowledge of these things, because one day we may have to defend against them.

"Temporarily incapacitating large numbers of people without permanent harmful effects is such a practical possibility that it might become a feasible enemy doctrine. An enemy agent could carry enough of some of these materials in a specially designed pencil to effectively demoralize a considerable number of people."

Dr. Van M. Sim

The Army's volunteer program at Army Chemical Center is a heavy responsibility for those in charge, according to Dr. Sim. In recent months 400 volunteers have been exposed to a number of new compounds without any harmful after-effects, a record of which Dr. Sim is understandably proud.

A veteran of five years' service as a Naval medical officer during World War II and the Korean War, Dr. Sim explains his reasoning on self-exposure this way. "It's not a matter of compulsiveness or wanting to be the first to try a material.

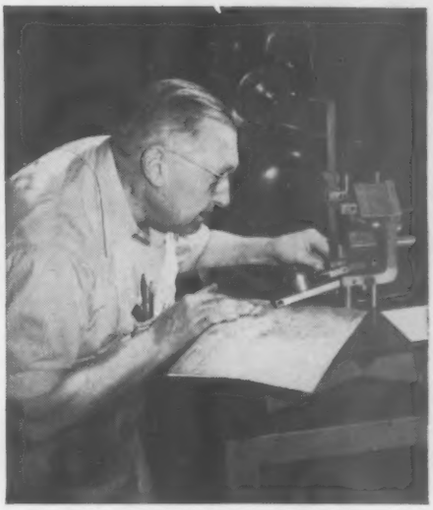
"With my experience, I am often able to change the design of future experiments after my own personal exposure. This allows more comprehensive tests to be conducted later, with maximum effective usefulness of inexperienced volunteers. I'm trying to defeat the compound and if I can, we don't have to drag out the tests at the expense of a lot of time and money."

Dr. Sim was recently the recipient of the Decoration for Exceptional Civilian Service, the Army's highest civilian award, and was cited for exposing himself to new agents "at the risk of grave personal injury . . ."

After five years of testing a myriad of materials, both here and in Great Britain, where he played a major role in that country's volunteer program, Dr. Sim is possessed with the assured self confidence of a man who knows what he's doing.

"Of course," he grins, "you wouldn't be human if you didn't think about these things occasionally, but I've never lost any sleep before a test. There's just not any apprehension any more."

Scientists research constantly to improve or design new safety equipment . . .



Tool-makers, with experienced hands, skillfully manufacture production tools . . .

Inspectors, sharp-eyed and trained, check every component and each assembly . . .

Technicians assemble and test instruments to detect explosive and toxic atmospheres . . .

Machinists with precision tools shape metals to meet vital tolerances . . .

Millers and mixers process crude rubber to assure the quality of rubber products . . .

MSA taps a variety of special skills to meet the requirements of government projects

There's a well-established source of knowledge and skills available—at MSA—for carrying out government contracts in research, engineering and production.

Many of these talents have already been employed on a wide range of government projects. Many more are at work full-time on the development and production of our complete line of safety products, numbering over 3600 in total.

Years of work in an environment of "safety firsts" provides MSA employees with a special knack for meeting rigid specifications. We'd be happy to submit our qualifications in detail for your evaluation. Write our Defense Products Department for more information.

MSA
SAFETY EQUIPMENT HEADQUARTERS

MINE SAFETY APPLIANCES COMPANY
201 North Braddock Avenue
Pittsburgh 8, Pennsylvania

At Your Service: 76 Branch Offices in the United States

CHEMICAL CORPS SCHOOL FACES ANOTHER DECADE

By
COL. WILLIAM H. GREENE
Commandant
U.S. Army Chemical Corps School

WITH THE PRESENT national concentration on CBR developments, the Chemical Corps School faces several real challenges. Are we teaching the right courses; are we stressing the right points; are our graduates really equipped to cope with the new problems of this new decade? This article is an attempt to summarize what we have at the School, what we are trying to do with it, and where we hope to go from here.

Forty years ago this summer, the embryonic CWS School moved from Lakehurst, N. J. to Edgewood Arsenal (now the Army Chemical Center) on the Gunpowder Neck in Maryland, and flourished there through fat years and lean until World War II was over. Today, transplanted again, it flourishes in the Choccolocco foothills of northeastern Alabama, adjoining the pleasant little town of Anniston. The countryside ranges in altitude from 700 to 1300 feet, and this helps somewhat to temper the summer's heat.

The physical plant, built to our specifications, is excellent, though it will shortly need some expansion to enable the School to meet the expanding requirements for trained Chemical Corps personnel. Several of the ranges of the post, Fort McClellan, have been especially adapted to meet our specialized requirements. The Fort has expanded its facilities to accommodate those students who attend on permanent change of station status, as well as the members of the Staff and Faculty. Also located at Fort McClellan, besides the post garrison, is the U.S. Army Chemical Corps Training Command and the Training Center, and the School of the Women's Army Corps, both of which conspire to keep us on our toes.

On the Chemical Corps portion of the post are located the Headquarters of the Chemical Corps Training Command, the barracks of the 100th Chemical Group, and an excellent parade ground, Bullene Field. The U.S. Army Chemical Corps Field Requirements Agency occupies part of the School building.

The buildings of the School group are dominated by the main School building—a two-story, L-shaped building with a striking tower over the main entrance. The entire building is air-conditioned in summer, and is very comfortable the year around.

Upstairs in the building are most of the classrooms—eleven single rooms and one double room when we need to combine several classes. There are two laboratories, beautifully equipped—one for biology and one for chemistry. There are storage rooms for training aids and for the multitude of publications that are required for resident and non-resident instruction. There is a bookstore, a small branch of the post exchange, that functions as a coffee shop and a barber shop, and a dispensary.

At the time the School was constructed, the latest procedure was to design air-conditioned buildings substantially without windows. It may also have been considered desirable to afford the student the opportunity to concentrate on his studies without the distraction of a view of the outside world. Whatever the reason, I do not consider this to be a desirable feature of the design, since whenever we have power failures, the entire upper floor becomes untenable, being without light or ventilation.

Each of the classrooms has ample blackboard space, and six sliding panels for the display of additional material. There is an ingenious screen at one side of the platform—transparent, with a mirror angled behind it—which permits the instructor to project his own transparencies from the lecture platform. Available on call are a sufficient number of motion picture and slide projectors for all needs of this type. In the training aids shop and the service shops of the School, we prepare many ingenious devices to illustrate many teaching points—miniatures of items too large to bring into the classroom, large-scale models of items too small to demonstrate from the platform, and slides and transparencies and printed materials for any lecture.

The ground floor of the School is occupied primarily with the offices of the Staff and Faculty. There is another laboratory on this floor—the Scaler Laboratory containing many of these ingenious electronic devices that measure radiation from radioactive samples. There is also located here our Graphic Arts Branch with its amazing equipment and talented people who can print, draw, paint, sketch or photograph anything that permits the

Main Entrance, School Building

Chemical Corps School Building, Radiological Laboratory and Bachelor Officers Quarters

Taking a Sample on BW Reconnaissance

graphic type of representation. Two of the offices near the Scaler Laboratory are used as additional classrooms. There is also a rapid reading clinic armed with tachistoscopes and shutter machines to permit us to train students in our longer courses to improve their reading speed and comprehension.

At the end of one wing, connected with the ground floor, is the Coughlan Auditorium. This is a beautifully appointed assembly hall—250 seats upholstered in Chemical Corps blue and gold, and a stage with all the appurtenances required to present training skits, training films, amateur theatricals and graduation ceremonies. Entrance to this auditorium is either from the main School building or directly from outside. On the walls flanking the seating area, two standards have been framed: the colors of the 30th Engineer Regiment, and of the 1st Chemical Regiment. These help to bring the traditions of the Chemical Corps home to the student on at least two occasions as he attends the School: at the welcoming ceremonies on his arrival, and at the graduation ceremonies as he is about to leave.

One of the most attractive rooms on the first floor is the Fisher Library, which consists of a high-ceilinged reading room with several study tables and some easy chairs. It offers ready access to many popular and scientific periodicals and to a far-ranging catalog of books in the many fields of interest of a present-day Army officer. The reference library is very complete, and multi-lingual as well. The recommended reading list of the Chief of Staff of the Army is on prominent display and in frequent use. Space has somehow been found to provide two floors of stacks for the storage of books, pamphlets, periodical files, and all the paraphernalia required for the insatiable inquisitiveness of an alert faculty and student body. Opening from this room are the security vaults with capacity more than equal to our current needs. Built into the walls of these vaults are drawers and deep bins with the necessary combination locks for material of any classification. The presence of these facilities enables us to eliminate classified material from most other areas of the School building and so reduce our security requirements.

Around the walls of the library, and here and there throughout the School building, are displayed the tokens of appreciation of various of the students who have attended the School from Allied countries. Whatever the intrinsic value of these mementos, they have been given to the School with a generous spirit, and one of my present concerns is to display them and to preserve them in suitable cases. There are colorful banners from the Nationalist Chinese, letters of appreciation framed in shiny black lacquer inlaid with mother-of-pearl from Korea, qualification badges from a class of Brazilian students, and other tokens of official gratitude or personal impulse.

Members of the Reserve and National Guard components will probably be interested in another set of offices also located on the ground floor of the School which houses the Publications and Nonresident Instruction Division of the School. This rather formidable title on the door leads one into a veritable warren of small offices where the writers and editors work who prepare the Chemical Corps manuals for the Department of the Army, who write the lessons for the extension courses and who grade the courses for over 2,500 reserve officers who participate in this part of our instruction. Here also are located the offices of the branch which has special responsibility for the work of the ROTC and the USAR courses in CBR warfare. The School is responsible that these units are visited at least once a year, and many of them are visited more than once to assist them in the technical aspects of their instruction.

Not every part of the School is housed in the main School building. We have several adjacent buildings whose functions are essential to the operation of the school. Closest, perhaps, is the radiological laboratory shaped somewhat like a spread-out letter U, with a classroom at either end of the building. Here, in a separate building, where the necessary safety precautions can be taken, students can work with live radioactive agents, measuring the effect on radiation of distance; practice shielding by brick, steel, water and other substances; and conduct other practical experiments in dealing safely with radioactive material.

Around the corner from this building is a Personnel Decontamination Station—a very complete structure that permits large numbers of people to be decontaminated in a short period of time. After exposure of our students to the various live agents with which they become familiar, they must go through this station to become aware of the procedures required after exposure. We feel that exposure of our students to live agents forms a very important part of their training.

Nearby is another building, McBride Hall, with two somewhat improvised classrooms designed to operate as adjuncts to the "Hardtop" demonstration area outside. Here our classes, particularly the enlisted classes, receive a thorough grounding in the care and handling of the flame thrower, the power-driven decontamination apparatus and the smoke generator. After a thorough drilling in the nomenclature and functioning of these items, the

classes move out onto the "Hardtop"—a paved demonstration area, and there they see these pieces of equipment and try for themselves.

Not far away is a gas chamber, strangely enough one of the most recently constructed buildings, which bears on the outside a large sign outlining the various steps of the gas chamber exercise. On the inside, it is divided into two rooms: one for the tear gas check of the fit of the gas masks, and one for the more serious test when the student learns to put on his mask in a lethal atmosphere of chlorine.

In addition to these buildings, essential to the conduct of actual instruction, there are several vital administrative buildings: quarters for bachelor officers of the staff, faculty and student body; supply warehouses and offices; and an airstrip and the associated hangars for the School's fleet of light aircraft and helicopters. These aircraft play a very important part in our instruction and administration.

Fort McClellan also affords many ranges for practical field exercises in all branches of our training. There is a range for demonstrations of chemical munitions, another for exercises in collecting non-pathogenic biological samples, others for smoke exercises and for rifle and pistol markmanship. One of the most interesting ranges is an area which can be made radioactive as needed, to provide practice in the reconnaissance of areas contaminated with radioactivity. Radioactive cobalt, in varying sizes, has been placed in a series of small pipes. Each element is so connected to a wire that it can be raised or lowered in the pipe as required. When the elements are raised to the head of the pipes, the radiation of the field is sufficint to register on the instruments carried by the students either in jeeps or in slow, low-flying aircraft. This facility has been used by several other Army activities in the neighborhood: by Pathfinder units from Fort Benning, and by the pilots of several nearby aviation units.

With this very complete, almost elaborate physical plant, the attention of the Staff and Faculty can be, and is devoted to keeping the quality of the instruction at the highest possible level. We are charged with presenting two types of resident instruction: educational and training. As we consider them here at Fort McClellan, *educational* courses are designed to develop the whole man—to help him become an officer in every sense of the word, ancient and modern. These courses cover the art and techniques of leadership, of self-expression, of management, and of military history and policy, as well as the more specific technical fields. The *training* type of course is usually a shorter course more directly pointed toward imparting specific skills to military personnel who, for the most part, already possess the necessary military background, or who will acquire it elsewhere.

Our educational courses are three. The first is the basic orientation course, designed to instruct the graduate of a non-specialized ROTC course in specific Chemical Corps subjects together with enough applicatory exercises of the subjects he should have learned in college to enable him to take his place as a junior officer with Chemical troops. Teaching these classes is a real challenge: the men are for the most part graduates and post-graduates of technical and scientific schools, accustomed to and critical of classroom routines. Most of them evince no interest in the Army as a career, but the overwhelming majority of them are determined to do a good job while they are in service. They do well in the technical subjects, as you might expect; they also do well and enjoy the specific details of administrative procedures—probably because they visualize that this is the sort of thing to which they will promptly be exposed on joining a unit. The most difficult courses, most of them find, are those that attempt to impart the art of working and getting things done through others—leadership, and human relations.

The other two educational courses are the advanced courses (they will be called the Chemical Branch courses)—the regular advanced class, which extends through the entire academic year, and the associate advanced class which is condensed into five months. We try to cover the same material in the two courses. Many of the lectures and exercises of the second half-year, when we present the associate chemical branch course, are conducted jointly for the two groups. The regular chemical branch class is composed of senior first lieutenants and junior captains—on the average in their fifth year of service. The associate chemical branch class is older than this average—many of their members are taking this course because their military assignments have not permitted them to attend earlier in their careers.

Both these groups are very satisfying for an instructor to work with. They are very serious about their work—they are career officers, and there is strong competition for grades and for favorable recognition from faculty and classmates. Discussion is animated and intense. The questions put to faculty members and to visiting lecturers are searching ones, and for this reason we try to bring to the platform senior Chemical Corps officers now in positions of command or comparable responsibility to give our instruction a practicality and an immediacy that otherwise might be lacking.

The specialized courses of the training type are of several varieties: CBR courses are for officer and enlisted personnel outside the Chemical Corps; radiological safety courses for military and civilian personnel; courses in nuclear weapons effects for Chemical officers; and courses for enlisted personnel at three levels: basic, intermediate and advanced. The advanced non-commissioned officer course has proved to be an outstanding one for the students, the instructors, and the commanders of the units from which the students come.

Students from Allied nations attend the associate chemical branch class and several of the specialized courses, sometimes one after the other. It is really remarkable the way these men are absorbed into the social, as well as into the academic life of the post. Their fellow-students help them over the rough spots in the academic work, and almost all of them find something in common with someone on the post. There is every evidence that upon their return to their homelands, these officers form a nucleus of great value; trained in CBR warfare and favorably disposed toward the United States. Needless to say this friendship extends both ways, and we have been much impressed with the tenacity with which these men have tackled complex subjects in an unfamiliar tongue, and have made themselves at home amid unfamiliar customs.

I would surely be remiss if I were to fail to mention the continuation of the long and friendly relations which have existed between the U.S. Navy and the Chemical Corps School. The Naval Unit is assigned to the Sixth Naval District, and supervised from the Bureau of Naval Personnel. However, without benefit of budgets or inter-Service agreements, or anything except a cordial local understanding, this unit occupies offices and a classroom in the School building, shares ranges and other facilities with the Army classes, provides our School with instructors in naval subjects, and is occasionally provided with our instructors for specialized technical subjects. The permanent Navy party is billeted on the post, and is a welcome part of our social and professional life here.

(Continued on page 29)

Chemicals you live by

Diamond produces the "Chemicals you live by"... for industrial and agricultural purposes, consumer use, and for our national defense. Diamond Alkali Company, 300 Union Commerce Building, Cleveland 14, Ohio.

Basic Alkali Products

58% Light Soda Ash
58% Dense, Granular Soda Ash
Bicarbonate of Soda, U.S.P. Powdered, Granular
Bicarbonate of Soda Free-Flo*
Sesquicarbonate of Soda
Modified Sodas
Caustic Soda
Solid, Granular, Flake, Crystal
Liquid Caustic Soda
50% NaOH
73% NaOH
Liquid Caustic Potash
Foundry Grade Soda Ash
Soda Ash Briquettes

Chlorine

Liquid Chlorine
Single-Unit Tank Cars
Multi-Unit Tank Cars
Barges and Pipeline Cylinders

Chromium Chemicals

Alumina Hydrate
Sodium Bichromate
Crystal, Granular, Liquid
Sodium Chromate
Potassium Bichromate
Chrome Salt Cake
Chromic Acid
Tanolins* (Tanning Salts)
Synthetic Tans
Tanning Oils and Fat Liquors
CPA 1800* (Chrome-Plating Additives)

Sodium Silicates

Silicate of Soda, Liquid
All Grades
Water White, 42°
Silicate of Soda, Concrete Special
Versilad* and Versilate* (Adhesives)
Silicate of Soda, Glass
Detergent Silicates
Moroc* Foundry Sand Binder
Sodium Metasilicate, Anhydrous
Sodium Metasilicate, Pentahydrate

Chlorinated Products

Muriatic Acid (Commercial and Water White)
Tank Cars
Anhydrous Hydrogen Chloride
Carbon Tetrachloride
Tank Cars and Drums
Chlorowax* 70 and 70S (Resinous Chlorinated Paraffins)
Chlorowax* 40, 50 and LV (Liquid Chlorinated Paraffins)
Perchlorethylene
Methyl Chloride
Methylene Chloride
Chloroform
Hexachlorobenzene
Hexachlorobutadiene-1, 3
Fire Extinguisher Liquid
Chloral
2, 4 Dichlorophenol
2, 4, 6 Trichlorophenol
Benzene Sulfonyl Chloride
Parachlorobenzene Sulfonyl Chloride
Parachlorobenzene Sulfonamide
Phenoxyacetic Acid
Ethylene Dichloride

Calcium Carbonates

Precipitated Calcium Carbonate Pigments for Paint, Rubber, Plastics, Glass and Printing Ink:

Suspenso*	Surfex MM*
Millical*	Multifex MM*
Non-Fer-Al*	Super-Multifex*
Carbium*	Kalite*
Surfex*	U.S.P. Dense

Cement and Coke Products

Portland Cement
Masonry Cement
High Early Strength Cement
Waterproof Gray Cement
Foundry and Industrial Coke
Benzol

Toluol	Xylol
Crude Ammonia	Tar

Detergents and Chemicals for the Laundry Industry

Laundry Soda
Diamond Soda Crystals
Laundry Sours
Laundry Liquid Blue
Hi-Ratio Silicate*
Hydrobreak*
Hydrolate*

Paralate*	Paralate*S
Alkalate*	Metalate

O & W Compound*
Ortholate
Sodium Metasilicate, Anhydrous
Sodium Metasilicate, Pentahydrate
Sodium Orthosilicate
Sodium Supersilicate
Suspensoil
58% Soda Ash
Washroom Control Kit

Industrial Cleansers and Chemicals for the Food, Dairy and Beverage Industries

Aquid* (Liquid Detergent)
Bomber* (Dairy and Creamery Detergent)
Cirkal* (for Mechanical and Circulation Cleaning)
Citrospeed*
Cleaner and Cleanser
Diamid* (Liquid Acid Cleaner)
Diamond Soda Crystals
Dreadnaught* Cleaner
Economy Cleaner
Special Alkalies (Causticized Ash, all strengths)
Special Alkalate
Hardnox Alkali* (Bottle Washing)
Hi-Speed* Cleaner
Hi-Test Alkali* (Bottle Washing)
Horizo* (Chlorinated Phosphate-Type Sanitizer)
HW Soaker Alkali* (Bottle Washing)
Diamond Detergent
Hydrolate*
Hydrobreak*
All-Purpose "W"* Cleaner
Compounds for Specific Uses
Modified Soda
BB Soaker Alkali (Bottle Washing)
Clipper Cleaner*
CH-100* and CH-101 (Bottle Washing)
Powdered Acid Cleaner
Pre-Mix Tank Washing Compound
Samson* Can Washing Compound

Sequet*	Sesquilate*

Neutral 50* Cleaner

Nu-Met*	Nutralac

Agricultural Chemicals

DDT (Technical and Concentrates)
BHC (Technical and Concentrates)
2, 4-D (Acid, Salts, Esters, and Formulations)
2, 4, 5-T (Acid, Salts, Esters, and Formulations)
Lindane (100% and Concentrates)
Miticide K-101 (Technical)
Hexachlorobenzene (Technical and Formulations)
Grain Fumigants
Dacfia
Diamond "80-20"*
Diamond Premium Brand

Plastic Resins and Compounds

Polyvinyl Chloride Resins
Diamond PVC-50 (High Molecular Weight—U.L. Approved)
Diamond PVC-45 (Medium Molecular Weight)
Compounds
Diamond Compound R4 (for Rigid PVC Applications)
Compounds for Specific Applications

Other Diamond Chemicals

Di-Aqua* (Wetting Agent)
Hydrogen

**Reg. U. S. Pat. Off.*

Diamond Chemicals

INCENTIVES AND LIMITATIONS IN USE OF INTELLECTUAL PROPERTY

By

HAROLD S. MEYER*

This article is substantially the paper by Mr. Meyer entited, "Restrictions on the Use of Intellectual Property Rights," included in a symposium on Intellectual Property, published originally in the *Cleveland-Marshall Law Review*, Vol. 9, No. 1, January 1960. Mr. Meyer has condensed and adapted his paper somewhat for presentation by THE JOURNAL here.

Grateful acknowledgment is made to the Cleveland-Marshall Law School, owner of the copyright of this article, for permission to reprint the paper as modified by the author.

THE JOURNAL, in its 1957 November-December issue, published an article, "American Patent Incentive System—Spur to the Useful Arts," which was prepared and submitted by a group in the Nation's Capital interested in furthering public knowledge of the patent incentive system. It appeared that that article was well received, and it is believed that Mr. Meyer's discussion will also prove of interest, not only to our readers in industry or government who are directly concerned with "intellectual property," but to Association members generally.

For bringing Mr. Meyer's paper to our attention, and for their time and effort in making it available for THE JOURNAL we are indebted to Mr. Paul L. Gomory, of Washington, D.C., and Mr. Virgil Woodcock, of Philadelphia, Pa., both members of the American Patent Law Association and active in programs aimed at promoting public knowledge and understanding of the laws pertaining to "intellectual property"—Editor

INCENTIVES for creative effort and for investment in new enterprises in our economic system are enhanced by patents and other intellectual property rights. The exploitation of these rights may only be accomplished within the framework of the general laws including the anti-trust laws. In the application of these laws certain practices have been limited or prohibited.

Study of the many complex situations presented in the decisions of our courts relating to certain practices shows that the difficulties which occur are generally in a few major areas, and that very real incentives continue to flow from the securing of intellectual property rights if a few guiding principles are followed.

Patents and copyrights are creatures of statutes, authorized by Article I, Section 8 of the Constitution. Patent rights, under the present statute, give the owner of a novel invention, who has obtained letters patent by compliance with the requirements of the law, the privilege for seventeen years of excluding others from practice of the invention, or of permitting it to be practiced on such terms as may be agreed on by a license. Copyrights, under the present statute, give the owner of a literary or artistic or musical composition, who has placed the prescribed notice on all copies published and obtained a registration certificate, the privilege for twenty-eight years, renewable for another twenty-eight years, of preventing others from copying the work, or of permitting it to be copied and used under a license.

Know-how and trademarks can be protected under general principles of law, apart from statutes, although we have a federal trademark registration law which gives important procedural benefits. Know-how remains the absolute property of its possessor as long as he does not disclose it to anyone else. Once disclosed, it becomes the possession of the recipient also, unless there is an agreement between the originator and recipient as to ownership, terms of use and the like. Trade mark names and trademarks are the property of those who adopt and use them in conducting a business, and constitute the specifically identifiable part of the goodwill of the business.

Anti-trust Laws

The name "anti-trust laws" is a curious misnomer, not found in the earliest statutes themselves, except indirectly, in the phrase "combinations in the form of trust or otherwise." This name arose from the historical fact that objectionable monopolies were being created by the device of placing in trust the voting stock of ostensibly competing business corporations, so that the trustees (who were not the beneficial owners) could use the control of the corporations to restrain freedom of business action and to obtain unfair advantages over others. Obviously, the anti-trust laws have nothing to do with trusts of the ordinary kind, and are in fact anti-monopoly laws.

The first of these laws was the Sherman Act of 1890, prohibiting in broad, general terms all contracts, combinations and conspiracies in restraint of trade or commerce, as well as attempts to monopolize any part of trade or commerce. The other laws, enacted in 1914, are the Clayton Act and the Federal Trade Commission Act. The Clayton Act prohibits a number of specific practices such as price discrimination, agreements requiring a customer not to purchase from a competitor of the seller, and mergers of competing businesses, when such practices tend to destroy competition; in each case with various qualifications intended to permit fair and non-monopolistic action. The Federal

* Mr. Meyer is a member of the Ohio Bar, a member of the American Bar Association Committee on Program for Protection of Industrial Designs, and a former vice-president of the Cleveland Patent Law Association.

Trade Commission Act prohibits unfair methods of competition and deceptive advertising, and established the Federal Trade Commission, which has the task of enforcing these restrictions and also some other functions.

Amendments have been made from time to time, in some of which exceptions to the general prohibitions have been established. Thus, the "fair trade" law of 1947 permitted a supplier of branded goods, which are in free competition with other like goods, to prescribe minimum resale prices if such arrangements are lawful in the state in which the resale occurs. In another special statute, originating over sixty years ago, owners of trademarks were given the right to prevent importation by others of goods bearing the same trademarks.

The general purpose of all these laws is to foster competition, and to ensure as far as possible freedom of opportunity for all to engage in any desired kind of business. Nevertheless, the system is a patchwork in which attempts have been made to cover up weaknesses, or to relax unduly stringent controls, in language which is often confusing and sometimes apparently contradictory in purpose or effect.

The apparent contradictions are especially troublesome with respect to ownership of such intangibles as intellectual property rights, partly because of the inconsistency between the legal concept of ownership as denoting absolute control over the property owned and the prohibition of some forms of control in the anti-trust laws. Even worse, patents and other intellectual property rights are sometimes characterized as legal monopolies, which some people find difficult to reconcile with our anti-monopoly laws.

Actually, Congress and the courts have established a balance for intangible property (as for any other kind of property) between freedom of use and restrictions on those uses regarded as injurious to our society. Those restrictions of greatest interest are outlined here.

Suppression of Competing Patents

Suppression of patents is often alleged. Typical examples have been the rumored purchase by a safety razor manufacturer of a permanent razor blade patent, or purchase by an oil company of an automobile carburetor patent which would double fuel mileage, and suppression of the invention by the purchaser to protect his established business in repeat sales of supplies. In such aggravated forms, suppression has never been proven.

Non-use of patented inventions is commonplace. Non-use may occur when a company develops and patents several different ways to accomplish a result, and exploits only that one which appears to be most advantageous, or when a particular invention cannot compete because of excessive cost or inefficiency or other failure to meet the needs of users. In other cases, inventors encounter the frustrating experience of being unable either to finance production and marketing or to persuade others to undertake such a financial risk (partly because our tax laws make it impossible to retain rewards for success commensurate with the magnitude of risks). But non-use alone is not objectionable and has not been characterized by the epithet "suppression."

Suppression of patents has been found to violate the Sherman Act, when the patents represent alternative or competing ways to accomplish a result, and are acquired for the specific purpose of eliminating actual or potential competition. This is true whether the patents are purchased directly or whether they are acquired by purchase of the business in which they are used. The courts have been particularly outspoken in condemning acquisition of competing businesses which are then discontinued. Acquisition of non-competing patents or businesses is not objectionable, especially when the acquired business is continued.

Conflicting patents are those owned by different entities but which cover the same industrial operation or product. Conflict between patents can occur when one person makes and patents an invention and another invents an improvement within the scope of the first patent. It can also occur when different people own patents on complementary inventions, such as a process and an especially advantageous machine for carrying out the process. The consequence is that each patent owner can prevent the owner of the other patent from practicing the conflicting inventions, so that the public will be deprived of any benefit of the inventions during the life of the patents unless the conflict is resolved. In such situations no objection is made to acquisition of patents for elimination of the conflict, as the result is to make available to the public something which otherwise might be unavailable.

Competition in supply of merchandise is not enough to assure maintenance of the maximum degree of freedom of business which is desirable in the public interest. There should also be competition in making of improvements. This is not brought out very clearly in the published cases, but it is definitely the policy of the Department of Justice to eliminate any arrangements which might restrict the freedom or the incentive of competitors to conduct competitive research, and thus suppress the creation of inventions.

Pooling of Patents

Pooling of patents means bringing under common control patents which were previously under different ownership, including arrangements between two patent owners as well as those involving patents of many owners.

Acquisition of conflicting patents in order to resolve a conflict has already been stated to be unobjectionable. Similarly, the resolution of a conflict by a cross-license, in which each owner grants to the other a non-exclusive license, is unobjectionable since it removes restrictions rather than imposes them. Such an arrangement permits the participants to compete with each other, and does not exclude competition by others who may be able to acquire the necessary patent rights.

Exclusive cross-licensing, on the other hand, is an agreement giving the participants, by joint action, freedom from competition for the life of the patents, and is therefore clearly an agreement in restraint of trade, prohibited by the Sherman Act.

These same rules apply to patent pools with more than two participants. Arrangements bringing together all patent rights needed for a particular industrial operation are approved if others than the parties to the arrangements are not excluded. Thus, pooling of patents is unobjectionable if the patents are individually licensed, or if a license under the group of patents in the pool is freely available on reasonable terms. Any restrictions on operations of the participants will cause the arrangement to be condemned as an illegal restraint of trade. This includes specifically restrictions as to prices which may be charged by the participants, all price-fixing in cross-licenses having been declared to be improper.

The grant of a license on condition that the licensee will grant a license back to the patent owner, to use the licensee's improvements, is a special form of pool-

ing. Patent owners are reluctant to license competitors unless they can acquire the right to use existing and future improvements made by the licensees. Otherwise, the licensees would be likely to acquire a competitive advantage by being able to operate under the original patent and also being able to prevent the owner of the original patent from supplying the improved form of the invention. Availability of a back-license under the licensees' improvements gives the patent owner an incentive to grant licenses to competitors, and has been specifically approved. But the use of back-licenses is not free from problems, since multiple back-licenses from several licensees would give the patent owner a preferred position (besides receipt of royalties) in being the only one able to use all improvements. On the other hand, an open pool, in which all existing and future improvements are available to all licensees, while it eliminates the problem just mentioned, could be criticised as lessening the incentive to carry out competitive research, and is actually distasteful to some important companies for that reason. A possible solution to this dilemma, which has been used sometimes, is to give the original patent owner a back-license from each licensee in any event, and also to give each licensee at the time of signature of the license the choice whether he wishes to acquire a license to use future improvements of other licensees in return for an obligation to grant a similar license to the other licensees. Of course, these problems do not exist at all if the patent owner and the licensees are not competitive.

Restrictive Licenses

It is clear now that a patent gives its owner only the right to exclude others from practice of the patented invention. He may agree not to exercise his right to exclude against a particular person or company, and such an agreement is a license. If that were all that was done, except to compensate the patent owner, as by a suitable royalty payment, there would be few problems. Licenses granted by a patent owner who is not practicing the invention are often as simple as that. Licenses to competitors are more troublesome.

Patent owners have found by experience that it is not always to their best advantage to try to maintain complete exclusiveness. Sometimes this would be impossible because the patentee could not finance the needed scale of operations. Sometimes exclusiveness would encourage others to design around the patent. Sometimes customers insist on multiple sources for patented products. In any event, royalty income can be attractive.

But the patent owner cannot be expected to favor licensing of a powerful competitor at the risk of having the licensee undersell or in some other way destroy the patentee's business. Consequently, various restrictions have been put in license agreements in order to protect the patentee's business, and many of these restrictions have been approved. Thus, a license agreement may require maintenance of a reasonable quality standard; or may limit the licensee's volume of business in practicing the patented invention; or may restrict the nature of the licensee's product, so as to avoid direct competition with the patentee. A license agreement may establish a minimum sales price for the licensed product, or may limit the territory in which the licensee is permitted to practice the patented invention. If the licensee is operating in a foreign country, the license may be limited to patents in a specified country or countries.

Both Congress and the courts have been asked repeatedly to outlaw these various restrictions in license agreements, and both have consistently declined to do so, although there have been strong minority opinions in the Supreme Court in favor of prohibiting these restrictions. The courts, however, have drastically restricted the usefulness of some of the restrictions in license agreements. Disapproval of price-fixing in cross-licensing has already been mentioned. Territorial restrictions in cross-licenses have also been disapproved. While the price charged by a licensee may be established, the resale price charged by the licensee's customer may not be fixed. The latter is actually only an extension of the rule that the patentee may not fix resale prices charged by his customers (except to the extent permitted by the "fair trade" laws, which are discussed below).

Use of identical restrictions in a plurality of licenses has never been explicitly disapproved by the courts, but the Department of Justice has taken the position that acceptance of a restricted license (one specifying a minimum price, for instance) with knowledge of previous grant of such a license to another, would be regarded as a prohibited conspiracy. The position of the Department of Justice at least constitutes a hazard that anti-trust suits might be brought against concerns that attempt to use such arrangements.

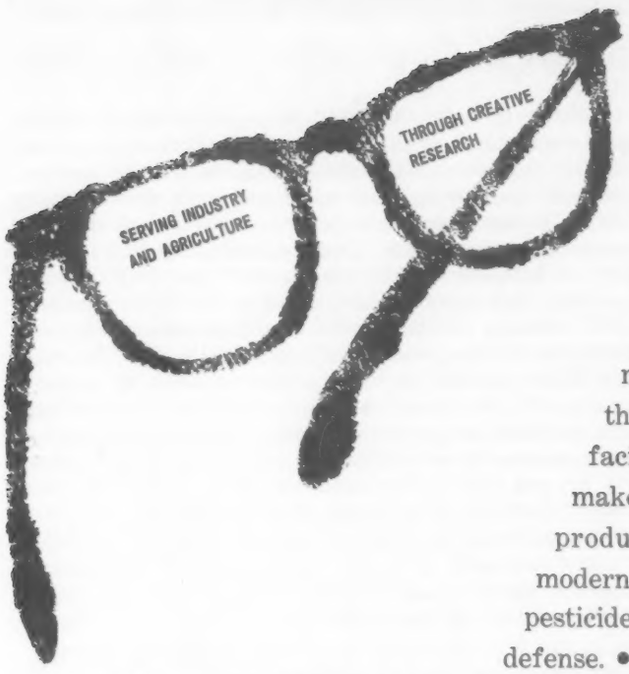
The most important limitation on restrictive licenses is that they are permissible only for the protection of the patentee's own business in practicing the patented invention. A manufacturing patentee can provide for some protection against harmful price competition by his licensee, but a non-manufacturing patentee may not fix the prices charged by his licensees. It has also been decided that a process or machine patent may not be used to fix prices for the product. Moreover, the patentee may not agree to restrict his own activities in any way, since that would definitely be a restraint of trade not justified in any way by ownership of the patent.

The patentee may, of course, make such unilateral decisions as are required in the conduct of his business, including whether or not he should practice the patented invention at all, the extent to which it should be practiced and the character of products made, the price which should be charged, whether a license should be granted to another, and if so, on what terms. So long as these decisions are the patentees' alone, there can be no conflict with the anti-trust laws. Also, to the extent already explained, restrictions can be placed on licensees, but restrictions can never safely be placed on the patent owners. The patentee, if he retains any control over the patent, must retain complete freedom to make all these decisions by himself. If he surrenders control over any of these things to a licensee, he has made an agreement in restraint of trade.

The only exception to the foregoing statement is that a patent may be sold outright (or exclusively licensed, which is practically the same, as the exclusive licensee is regarded as the equitable owner). The original patentee is replaced by the new owner, who must thereafter be the one who alone can make the decisions as to how to deal with the patent.

A corollary of this principle that the patentee must make the decision unilaterally is that any restrictions on the grant of further licenses are illegal, including any veto power by a licensee. An exclusive license implicitly includes the right of the licensee to grant further licenses, but it is best for the license agreement to state explicitly that the exclusive licensee shall have the right to grant sublicenses, to avoid any possible

(Continued on page 34)



FMC's Princeton Research and Development Center is dedicated to a

NEW DECADE OF CHEMICAL ACHIEVEMENT

FMC's multi-million dollar Princeton Research and Development Center is a significant contribution to the chemical industry. One of the most advanced installations in the country, it will open new avenues for chemical development and application technology. • The Center is designed to conduct basic, long-range research and intensive product development in close cooperation with FMC's five Chemical Divisions. At the same time, it will serve to coordinate the activities of these Divisions with the Corporation's other nation-wide technical facilities. • The result of such cooperation will make possible the development of finer chemical products to serve the complex requirements of modern technology—new plastics for electronics, new pesticides for agriculture, more efficient rocket fuels for defense. • FMC's expanding technical program offers a challenging future for skilled research and development people on all levels. It also provides the diversification necessary to serve a broad base of customers in government, industry and agriculture.

Putting Ideas to Work

FOOD MACHINERY AND CHEMICAL CORPORATION

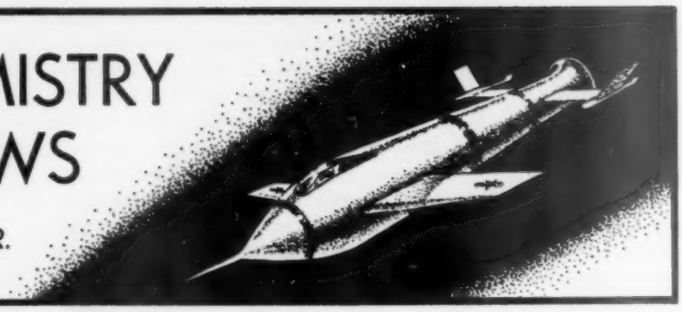
Chemical Divisions

161 East 42nd Street, New York 17, N. Y.

PRODUCTS OF THE FMC CHEMICAL DIVISIONS: BECCO CHEMICAL DIVISION—hydrogen peroxide and peroxygen chemicals; CHEMICALS & PLASTICS DIVISION—DAPON® and OXIRON resins, plasticizers and organic chemicals; CHLOR-ALKALI DIVISION—alkalis, solvents, and chlorinated products; NIAGARA CHEMICAL DIVISION—agricultural chemicals and pesticides; MINERAL PRODUCTS DIVISION—phosphates, barium and magnesium chemicals. Our 34-page brochure describing hundreds of FMC chemical products available on request.

DEFENSE CHEMISTRY IN THE NEWS

WILLIAM T. READ, SR.



This Department consists of condensations of news releases and of articles in technical journals relating to developments in chemistry, chemical engineering, and kindred subjects, which are of definite or probable military interest. For the benefit of readers who may wish to refer to the source material upon which the paraphrased items are based, the source publications used for this review with appropriate reference numbers are listed after the last item of the text herein.

METALS

Of the three metals for which greatly increased importance in the space age was predicted several years ago, beryllium has shown the greatest progress in comparison with that of magnesium and calcium. A total production of 300,000 pounds in the United States is expected in 1960, and growth in the next few years as much as ten-fold seems probable. The metal is hard to work with, being toxic as a powder and very brittle as a solid. Its tensile strength is greater than that of aluminum; it is more rigid than magnesium, with about equal weight; and it is comparable to steel in temperature properties. Its rigidity makes it particularly valuable in the fields of aircraft and missiles. Powder metallurgy is still the major method of fabrication. Magnesium has a firm position in the aircraft industry, but greater gains are expected in casting and wrought products, particularly in automotive die casting and in alloy development. Progress in the calcium field is dependent on new developments in other metal fields. As an additive to iron and steel, it reduces sulfur, hydrogen, and oxygen very rapidly. It is also employed as a reducing agent in the production of such metals as thorium vanadium, and special-purity chromium. (1)

A refractory alloy made up of 90% tantalum and 10% tungsten with a maximum of 150 p.p.m. of carbon, oxygen, and nitrogen, and with reduction of metallic impurities considerably below trace limits heretofore considered permissible, has been announced. It may be used between −200°F and 5200°F. The first crude ingot is made from a cold-pressed mixture of tantalum and tungsten powders, from which the finally highly purified alloy is produced. Purification is accomplished in an electron beam furnace. Welds resisting impact at room temperature can be produced either by inert arc or electron beam methods. (2)

Out of three processes for plating tungsten on less resistant metals and on ceramics, and also for forming tungsten articles, the most recently announced depends on the contact of a mixture of hydrogen and tungsten hexafluoride with a surface heated to 650°C. The hydrogen fluoride released is removed from the hydrogen by absorption in a trap. The coating is hard, quite dense, and purer than commercial tungsten. Silicon content is of the order of 0.1%. Structural strength above 2000°C is characteristic of tungsten, but the metal is not machinable by ordinary methods. Vapor deposition permits the necessary shaping of tungsten articles. (3)

Gold is now being plated by application of organic gold compounds of the type of gold alkyl mercaptides. Similar derivatives of other precious metals may be used. Among these gold compounds are gold tertiary butyl, tertiary dodecyl, tertiary octyl, and tertiary hexadecyl mercaptides. These metallo-organics decompose at temperatures as low as 400°F to 500°F to form a continuous metallic film. Among the applications of such coatings are heat-reflecting protection for plastic laminates in jet-plane dragchute containers, Atlas missile blast shields, and the stainless steel of aircraft honeycomb structures, and for aluminum, magnesium, and titanium jet-engine shrouds. The lower decomposition temperatures extend the use of this type of plating beyond that of the metal resinates, which required 750°F to 800°F. This limits them to use on glass and ceramics. Research is being carried on to find gold organic compounds that will require still lower decomposition temperatures which would permit application to low-melting plastics. (4)

NUCLEAR CHEMISTRY

The Atomic Energy Commission now disposes of some low-level radioactive wastes at sea, but, in anticipation of either convenience or economic factors, is making plans to establish inland disposal sites for low-level, packaged wastes. These areas will be on land already owned by the Federal or state governments. Thorough investigations will be made in each case of all the characteristics of the site to insure that there will be no escape of radioactive material and contamination of the general environment. Sites will be continually and effectively monitored. It is estimated that all of the radioactive wastes from Oak Ridge in the past 15 years could have been safely taken care of in 60 acres of properly situated land. Not more than 200 to 300 acres are expected to be needed in the next 20 years. (5)

Radiation as a technique to permit chemical reactions that are not possible with the usual reagents and methods has been given a boost in the fluorination of aromatic compounds without destruction of the ring, as is the case with elemental fluorine. Carbon tetrafluoride and boron trifluoride are the new fluorinating agents that are employed along with radiation to make such compounds as m-fluoronitrobenzene. Several fluorinated benzenes have been made. Fluorine compounds are expected to have properties making them of military usefulness as munitions, lubricating and hydraulic fluids, and plastics. So far those compounds that have been made are quite expensive, as often happens in a new field. (6)

Automatic weather stations that are expected to operate for as much as two years without attention are being designed and built to employ strontium-90 as a

power source. A steady output of 5 watts is said to be possible from one pound of strontium titanate, the energy to be fed into rechargeable chemical batteries. Digital-coded weather data will be collected and sent out at intervals of three hours. (7)

ELECTROCHEMISTRY

Until very recently not more than 18% of chlorine produced in this country was made in mercury cells, but one large chemical company has just announced that it will add a number of high-amperage mercury cells to its present equipment of diaphragm cells. Power being a primary consideration, increase in the use of the mercury type cell will probably be in areas of low power cost. Another factor is the higher purity of the caustic made at the same time, mercury-cell caustic rarely containing more than 0.002% sodium chloride. Diaphragm cells make a caustic that has several times this much after purification. Caustic potash is being increasingly employed in the liquid detergent industry in making potassium phosphates. Mercury cells use potassium chloride as well as sodium chloride, and low chloride is an important factor in their product. Since the yield of caustic potash is higher than that of caustic soda in proportion to its greater molecular weight, less evaporation of the product is required. Diaphragm cells, however, are expected in the immediate future to make the larger part of electrolytic chlorine and caustic soda. (8)

The first steps toward producing an electric current from a partially ionized conducting gas, heated by commercial fuels and operating in a magnetic field, have been taken by a unit that has put out 2.5 kilowatts while running four minutes. The device is still in an experimental stage, and requires much more research in materials, designs, and chemical reactions. Thermoelectric generators in which the gas has been heated by an electric arc are in operation, but this new development has as its goal the generation of electricity by the heat of combustion of readily available fuels. The new magnetohydrodynamic generator depends on seeding the fuel with potassium or cesium compounds, which will reduce the temperature needed to make the gas conducting well below the 5000°F required in previous arc-heated generators. Hot ionized gases are made to flow through a magnetic field at right angles to the flow. The materials used to develop the necessary heat in this generator are furnace oil containing a potassium soap and oxygen. Water-cooled side walls are lined with zirconia. A major problem is that of refractory materials that will operate without serious damage at the temperature that will produce the desired temperature with seeding. (9)

Two types of high-temperature insulation for electrical wire have been developed for the Air Force. For wire that must be as light as possible, the technique involves covering copper wire with a barrier layer to prevent diffusion of the next layer of aluminum at higher temperature, the upper limit being 1500°F. The anodized aluminum was further sealed by coats of siliceous frit and resin to prevent dielectric breakdown from moisture. The second type of insulation is produced by drawing copper wire through a ceramic slip, followed by firing. A second application fills pinholes and gives uniformity in the coating. Some oxidation of the copper appears to be desirable for better electrical conduction at higher temperatures, a thickness of 0.1 mils representing the maximum of coating thickness necessary. (10)

INORGANIC CHEMICALS

The first plant to produce elemental sulfur from deposits beneath the surface of the ocean is expected to be in operation early in April. This plant is located seven miles off the Louisiana coast in the Gulf of Mexico to bring to the surface the sulfur of Grand Isle dome. The heating plant is designed to raise an average of 5 million gallons of water daily to a temperature of 325°F at a pressure of 400 p.s.i.g. An undersea pipeline with a capacity of 4,500 long tons of sulphur per day will convey molten sulfur the seven miles to the coast, from which it will be taken in barges another twenty-five miles to the storage and loading terminal on the Mississippi River. Three concentric pipes make up the main pipeline, these being a protective casing, a hot water jacket, and an inner sulfur line. Attached to the main assembly of concentric pipes are two other lines, one to return spent heating water, and the other to provide fresh water to the plant in limited supply. Sea-water is brought to the required temperature and pressure in a series of preheater towers, centrifugal pumps, and heat exchangers, from which it is forced into the wells. The major part of the plant is supported on a Y-shaped steel "island" which is 60 feet above the surface of the sea. Bridges connect to directional drilling platforms. Operating personnel will live at the plant and work five consecutive 12-hour days, after which they will be off duty on the mainland for five days. Helicopter transportation is provided for staff members. The Grand Island is said to represent the third largest sulfur deposit in the United States. (11)

Sulfur dioxide from smelter gases is made to a considerable extent into sulfuric acid, but there are smelters whose location makes shipping of the acid to distant markets uneconomical. Elemental sulfur, however, weighs about one third as much as sulfuric acid, and sulfur from this source may be competitive with Gulf Coast sulfur in certain localities. A large pilot plant costing $500,000 has given encouraging results in a process by which sulfur dioxide is reduced with natural gas, propane, or fuel oil over a catalyst with production of sulfur of commercial grade. (12)

A process recently imported from Switzerland makes possible production savings in the manufacture of anhydrous hydrogen fluoride, which is now used in the United States to the extent of 200,000 tons per year. Dried and specially treated calcium fluoride containing not more than 2% water is mixed with 96% sulfuric acid in stoichiometrical amounts, and the mixture is introduced into an oil-fired kiln. The calcium sulfate so made is a dry solid instead of the corrosive slurry of other processes, and can be marketed directly. The evolved hydrogen fluoride gas is condensed and needs only to be washed with concentrated sulfuric acid to give a 99.9% pure anhydrous product. The largest single use of hydrogen fluoride is in making aluminum fluoride and synthetic cryolite for the aluminum industry. Next in order is the hydrocarbon field, particularly refrigerants and plastics. Uranium tetrafluoride and hexafluoride are employed by the Atomic Energy Commission, the former for making metallic uranium and uranium oxide, and the latter in the diffusional separation of uranium-235 from uranium-238. The steel industry uses some inorganic fluorides in a process for surface hardening, and fluorides are added to many water supplies to prevent tooth decay in children. Some hydrogen fluoride functions in the alkylation of high-octane gasoline. Very little is used as yet as a rocket fuel. (13)

Continuous generation of a 2:1 hydrogen-oxygen mixture in homogeneous nuclear reactors employing uranyl sulfate constitutes a serious explosion hazard. The most satisfactory method to bring about the recombination of these two gases before they can accumulate in dangerous amounts is by employing copper salts as a catalytic material. Long tests with a reactor which has operated successfully for several thousand hours on an experimental basis have proved the efficacy of this technique. About 10 cu. ft. of the explosive mixture, released when no catalyst is used, are produced each minute for every 1,000 kw of energy derived from fission. (14)

Exhaled carbon dioxide from the occupants of space vehicles is proposed as a continuous source of oxygen for inhalation by means of a process which employs hydrogen in the presence of iron. Carbon and water are obtained by trapping these materials from intermediate reduction products returnable to the process. The water is then broken down to hydrogen and oxygen, the former being employed repeatedly for the first reduction operation. The process is planned to be operable for several years. (15)

Magnetic inks, now being used by some of the larger banks in handling checks, but quite likely in the future to be extended to sorting equipment for a great variety of both civilian and military documents, presents many technological problems, some of them chemical. Most of the oxides in magnetic inks have as their main ingredient magnetic iron oxide, Fe_3O_4. The particles have the form of fine needles with an average length limited to less than one micron. A solution of iron salts is made alkaline to precipitate hydrous ferric oxide. This is dehydrated to ferric oxide, which is reduced to black ferrosoferric oxide. This pigment is supplemented by carbon black, and the total pigment in the ink must be around 60%. Such ink has poor covering qualities, does not spread well, and tends to settle and to take up water. Printers must depend very heavily on the technical-service departments of ink manufacturers. In addition to the chemical problems, there are many of a physical nature. (16)

ORGANIC CHEMISTRY

Prospects now appear good for a switch from a kerosene cut to a mixture of hydrazine and unsymmetrical dimethyl hydrazine (UMDH) as a fuel for the largest of intercontinental ballistic missiles, together with replacement of liquid oxygen by the more easily stored nitrogen tetroxide. A new process for making hydrazine by flame pyrolysis and quick quenching may add to the availability of this type of fuel. Nitrogen tetroxide comes from nitric acid plants, and increase in its use would only require added facilities of the present type. Slight lowering of specific impulse with the new combination is compensated by ability to store more of the denser mixture in the missile. (17)

Mineral oils have been largely displaced by synthetic lubricants where extreme temperatures are involved. Recently, however, several processes have been developed which may restore mineral oils to their former position through products that can handle high temperatures better than their synthetic rivals. A mineral-oil lubricant is now under test and evaluation by the Air Force which has a -75°F pour point and a thermal and oxidation stability up to 700°F. It is made by severe hydrogenation, distillation through a 25°F boiling range, and extraction of paraffins by a high-molecular weight ketone at -80°F. Urea dewaxing, already successful with special low-pour-point auto transmission oil, is being studied with a view to making not only lubricants but hydraulic oils that will stand up under extreme temperatures. (18)

The term, "oxo" process, by which olefins are converted by synthesis gas (carbon monoxide and hydrogen) into aldehydes and thence to alcohols has led to the description of many compounds as "oxo chemicals" that are made by other processes. However, the term has become quite firmly fixed in the terminology of chemical industry. Its origin goes back to the early days of the process in which ethylene was used and both an aldehyde and a ketone were formed. Ketonization is described in German as "oxierung," which became "oxo" in commercial language. Present capacity of plants making alcohols ranging from C_4 to the higher alcohols is of the order of 264 million pounds per year. In addition to such markets as detergents, vinyl plasticizers, and synthetic lubricants, these chemicals are of a very varied nature and have many other uses for which they are bought in smaller quantities. In addition to a number of alcohols, such compounds as aldehydes, acids, and esters are final products of the original reactions between olefins and synthesis gas. (19)

A serious warning has been issued regarding the danger of organic derivatives of perchloryl fluoride, ClO_3F. The growing importance of perchlorates and fluorine in the field of rocket missiles has directed the attention of chemical industry to many other important possibilities of their derivatives. Perchloryl fluoride itself is relatively safe, has about the physiological effects of chlorine, and is detectable in concentrations as low as 10 p.p.m. by a sweetish odor. Perchloryl benzene is typical of shock-sensitive aromatic perchloryl derivatives. This is particularly true of their polynitro compounds. The stability of perchloryl fluoride is explained by its molecular symmetry, three oxygen atoms and one fluorine atom being distributed about a single chlorine, the bond between the two halogens being direct. As a powerful oxidizing agent, its handling may be of the same type as that of liquid oxygen. It is regarded as a safe and storable oxidizer when employed in liquid rocket fuels. Careless handling of this useful fluorination reagent in the presence of organic materials, particularly those that are finely divided, is a constant source of great danger. (20)

Dimethyl sulfoxide is proving a most versatile chemical in the plastics and protective coatings industry. It precipitates polyacrylonitrile-cellulose acetate fiber from solution, and is also a solvent for polyvinyl acetate, polyacrylic esters, polyvinyl chloride, and chloroprene. It has been used in textile printing, and is particularly valuable as a solvent for epoxy varnishes. It dissolves acetylene, ethylene oxide, and phenanthrene. Dimethy sulfoxide is made by oxidizing dimethyl sulfide with nitrogen dioxide, the oxidant being easily regenerated. An abundant source of dimethyl sulfide is waste kraft pulping liquor. (21)

PLASTICS

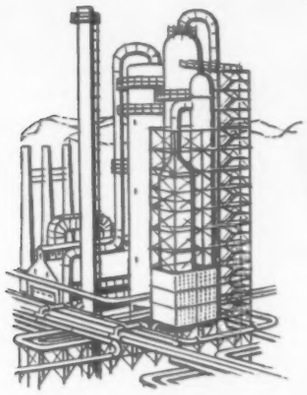
A new plastic made by the polymerization of gaseous hexafluoropropylene and tetrafluoroethylene is now available which can be extruded or molded by standard equipment. This is in contrast to polymers made from tetrafluoroethylene alone, which are now processed like powdered metals. The copolymer is not as heat resistant, however, being limited to temperatures up to 400°F, but resists cold as well as the older type of fluorinated polymers, and has somewhat better impact resistance at low temperatures. It has the same chemical resistance, electrical insulating properties, and

(Continued on page 28)

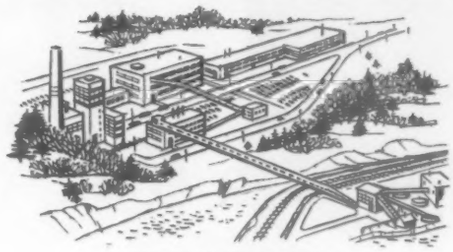
Over 50 years of world-wide experience on over 800 major installations for the process industries

LUMMUS

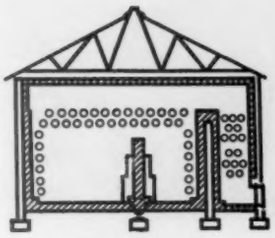
GIVES YOU MAXIMUM RETURN FOR YOUR CAPITAL INVESTMENT!



Petroleum Refineries

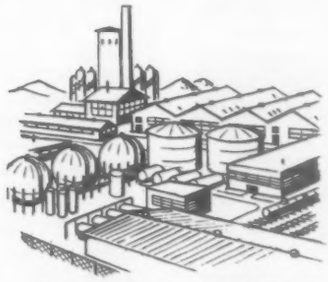


Pulp and Paper Mills

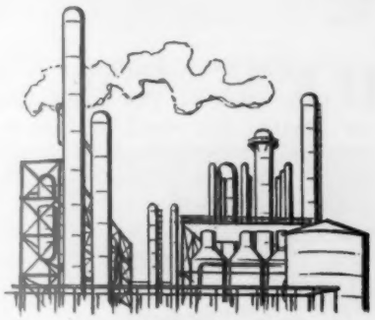


Oil Heaters
(Oil Heater Division)

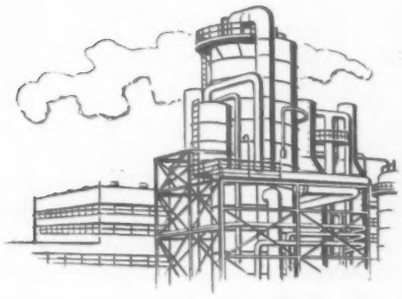
Economic Study and Consulting Services



Agricultural Chemical Plants

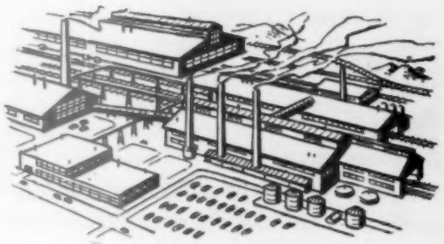


Petrochemical Plants



Chemical Plants

Pilot Plant Work
(Engineering Development Center)



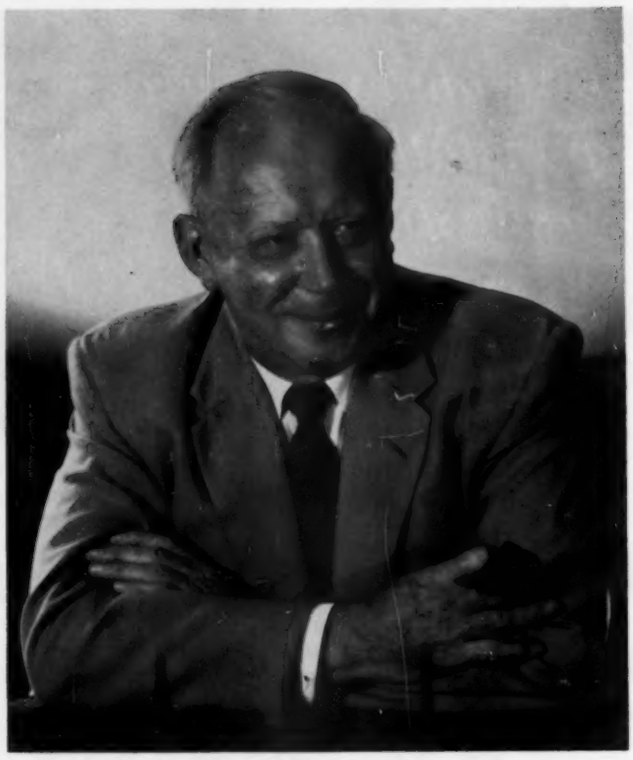
Metallurgical Plants

LUMMUS

ENGINEERS AND CONSTRUCTORS FOR INDUSTRY THROUGHOUT THE WORLD

385 MADISON AVENUE, NEW YORK 17, N. Y.

NEWARK • HOUSTON • WASHINGTON, D. C. • MONTREAL • LONDON • PARIS • THE HAGUE • MADRID



DR. RALPH E. GIBSON

NEW HONOR FOR DR. GIBSON

DR. RALPH E. GIBSON, Director of the Applied Physics Laboratory of The Johns Hopkins University, Silver Spring, Maryland, and former Vice-President of the Armed Forces Chemical Association, was presented the Captain Robert Dexter Conrad Award last March, during a three-day symposium at the Huntington-Sheraton Hotel, Pasadena, California, on "Naval Problems in Electromagnetic Radiation," sponsored by the Office of Naval Research.

The award, consisting of a medal and citation, was established by the Office of Naval Research and is made in recognition of and reward for outstanding achievements in research and development for the Navy. It is named for the late Captain Robert Dexter Conrad, USN, the primary architect of the Navy's basic research program.

Dr. Gibson was chosen as the recipient of the 1960 award for his individual research contributions and for his contributions to the Navy. The latter include the technology of solid propellant unguided rockets and the development of guided missiles.

Before World War II Dr. Gibson was a physical chemist at the Geophysical Laboratory, Carnegie Institute of Washington, Adjunct Professor Chemistry and Member of the Graduate Council of the George Washington University. Under the National Defense Research Committee he took personal charge of the development of solid-rocket propellants, which proved of major importance in World War II and in the Korean conflict.

The citation of Dr. Gibson, signed by the Secretary of the Navy, states:

"For outstanding contributions to the development of solid rocket propellants and guided missiles. As Vice-Chairman of Section H of the National Defense Research Committee and later as Director of Research of the Allegany Ballistics Laboratory, his foresight in appreciating the potentialities of solid propellants for assisted take-off of aircraft, for unguided rockets and guided missiles, and his effectiveness in speeding development, were major factors in the successful outcome of World War II and of the Korean campaign.

"As Director of the Applied Physics Laboratory of The Johns Hopkins University, his leadership both as a scientist and administrator made possible the successful transition from wartime to peacetime activities, and from fuze development to guided missile development in the Laboratory, thereby hastening the introduction of the operational guided missiles into the Fleet."

Dr. Gibson has served as Director of the Applied Physics Laboratory since 1948. Largely through his efforts, the Laboratory has become one of the Nation's leading activities in the development of guided missiles.

For his part "in providing brilliant and inspired leadership" in the development of TERRIER, with which the USS *Boston*, first operational guided missile ship, is armed, Dr. Gibson was given the Navy Distinguished Public Service Award in 1958.

Dr. Gibson received both his B.Sc. degree in chemistry, summa cum laude, and his Ph.D. from Edinburgh University. He has been awarded the Crum Brown Medal in Chemistry and the Hope Prize Scholarship in Chemistry from Edinburgh University where he was a Carnegie Research Fellow. For outstanding service during World War II he received the Presidential Certificate of Merit.

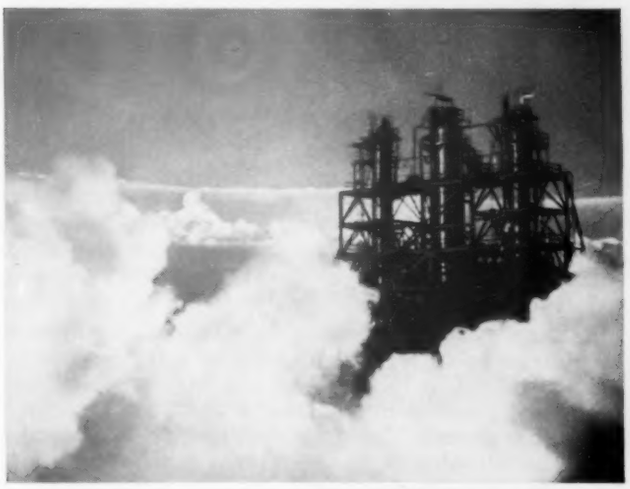
ALLIED CHEMICAL

...through 3,000 chemicals...opens doors to better products... for home...for farm...for industry...and for the new age of space

New decorative ceiling tile and insulating plank enable do-it-yourself fans to get "new rooms for old" in short order.

New fertilizer filling stations, in prime agricultural areas, let farmers "fill 'er up" as easily as buying gasoline.

New plastic-foam trailer panels, with urethane "filling," reduce weight, increase capacity, and are easy to install.



New boost for rocket engines is being attained by Allied Chemical developments in nitrogen and fluorine.

For booklet listing our principal products and sales offices write today to Allied Chemical Corporation, 61 Broadway, New York 6, N. Y., or phone HAnover 2-7300. (In Canada: Allied Chemical Canada, Ltd., 1450 City Councillors Street, Montreal.)

BASIC TO AMERICA'S PROGRESS

Allied Chemical

DIVISIONS: Barrett • General Chemical • International • National Aniline Nitrogen • Plastics and Coal Chemicals • Semet-Solvay • Solvay Process

WHAT'S GOING ON THERE?

Advances in Army weaponry intensifying the difficulties of observing an enemy have caused the Army to embark on a three-phase research and development program for improving technical observation means and avoiding the plight of "a blindfolded dart thrower." Following is a condensation of an article, "On-Target Readiness the Goal as—Combat Surveillance Looks to the Future," a discussion of the Army's attack on this observation problem, by *Brigadier General William M. Thames*, Commanding General, U.S. Army Combat Surveillance Agency, originally published in the March 1960 issue of the *Army Information Digest*, official U.S. Army magazine.

PARADOXICALLY, U.S. Army advances in the missile field in the last two decades have generated several significant problems while achieving major tactical advantages. One problem, or complex of problems, stems from the fact that Army weaponry has outstripped our ability to observe the enemy. This has left our Army in a situation roughly comparable to that of a blindfolded dart thrower. The compelling implications have brought about the Army's present research and development program in the combat surveillance field.

Department of the Army defines combat surveillance as a "continuous (all weather, day and night) systematic watch over the battle area to provide timely information for tactical ground operations." To fulfill this requirement, ACSA engages in a program of research and development to produce both airborne and ground surveillance systems. Efforts in this field fall under the staff responsibility of the Chief of Army Research and Development and under the direct supervision of the Chief Signal Officer.

The Army Combat Surveillance Agency (ACSA) was established by the Army Chief Signal Officer in 1957 to supervise and direct his effort in all phases of the combat surveillance field. . . . Within the guidance of the Assistant Chief of Staff for Intelligence, who has overall staff responsibility for combat surveillance, it formulates programs for development of a combat surveillance capability for the Army. It surveys established requirements, interprets these requirements into terms meaningful to industry, and oversees the ensuing developmental program. . . .

Objectives

Because ACSA is striving to produce certain new capabilities in an area where none of significance previously existed, it has been necessary to phase its development program into current, mid-range, and long-range time periods. The program is designed to accomplish the following:

Current time period. ACSA will meet immediate requirements by providing the Army with the best equipment now available or in the final stages of development. In other words, the initial equipment will be largely "off the shelf" equipment adapted as necessary to enable its use in the surveillance role. The surveillance radar and photographic equipment that is now finding its way into Army units illustrates the partial fulfillment of this objective.

As the current objective is attained, and as rapidly as areas are determined in which "first generation" surveillance equipment requires improvement, ACSA can accelerate concurrent efforts to proceed to its second objective. . . .

Mid-range time period. By 1962-1965 it is ACSA's second objective to develop an advanced interim capability in the combat surveillance area. This will involve use of the best techniques that the state-of-the-art allows. Attainment of this objective—now in process—will provide equipment that will take advantage of the experience gained in accomplishing the first objective.

Long-range time period. The third objective is to accentuate research and development within associated fields in order to advance the existing state-of-the-art and to exploit technical breakthroughs. Attainment of this objective will provide the Army with a greatly improved and highly effective combat surveillance and target acquisition capability. . . .

Principal Surveillance Areas

Speaking broadly, the principal ACSA developmental activities are grouped into two areas—ground and airborne surveillance systems. Both categories are concerned with developments in the fields of radar, infrared detection, acoustic and seismic sensors, and photography. Techniques and equipment within these fields are under intensive study with a view to the production of equipment that will be simple, reliable, as inexpensive of maintenance and logistical requirements as possible, and sufficiently light to be transported by the echelon for which it is intended.

Much attention is being devoted to the development of airborne surveillance systems. ASCA planners do not envision a reduction in the tactical use of manned aircraft, but rather an expansion of the use of aircraft and its human observer, with the observer's capabilities supplemented by sensory equipment.

Advances in the field of antiaircraft weaponry make it clear that attrition of aircraft in future war will make the use of drones desirable. This has led to development of drones carrying appropriate sensory equipment that can penetrate enemy lines at very low altitude, survey enemy-held areas of interest and then return with the information or transmit it to the home base while still in flight. These drones, gifted as they are with a sense of "inherent courage," will be equipped with combinations of infra-red, radar, and photographic sensors. Selection of the sensor to be used will be based on prevailing weather and type of mission.

Ground surveillance equipment will include lightweight radar sets that are designed to detect intrusion,

infrared viewers, and acoustic or seismic detectors that will provide information of enemy presence in distant areas.

Progress to Date

Already the ACSA program has resulted in an initial payoff. Long-range ground radar sets have been furnished to overseas tactical Army units. These radars give division artillery commanders a capability of detetcting enemy movement at night and during periods of reduced visibility. They enhance unit security in darkness, and facilitate bringing fire on points of enemy activity.

Army forces overseas have been provided with airborne radar surveillance systems capable of detecting vehicular movement in enemy rear areas despite overcast or darkness. Had this equipment been available during World War II, it could have detected the German build-up that preceded the Battle of the Bulge. Had it been available in Korea, it could have torn the cloak of darkness from Communist resupply activities.

A drone surveillance system, the AN/USD-1, is in the hands of our overseas unit. This system, the forerunner of others to come, is presently designed only to provide photographic coverage of enemy-held areas that cannot be reached by manned aircraft. . . .

Training Problems

Introduction of the first electronic combat surveillance systems into tactical units commenced about mid-1959. In order to insure the arrival of trained personnel to operate and maintain that equipment, the Deputy Chief of Staff, Operations, formulated a detailed training plan. Headquarters, U.S. Continental Army Command established the U.S. Army Combat Surveillance and Target Acquisition Training Command at Fort Huachuca, Arizona, to train surveillance specialists. . . .

Soldiers, selected with great care, were scheduled to complete training at Fort Huachuca at a time that would insure their arrival at the parent unit concurrent with delivery of the surveillance systems. This required a high degree of centralized control over the relatively few specialists involved but the system worked and the caliber of specialists so trained has been found to be high.

The Future

The systems that have been furnished overseas units thus far are the beginning, not the ultimate. Although they provide a limited capability, they do not fulfill the Army's entire combat surveillance requirement. That they have shortcomings is recognized by the fact that their successor systems are presently under design. We can best learn by doing—and the use of the "first generation" combat surveillance equipment that has now been issued will enable ACSA to take advantage of the ideas that are generated by those who use the equipment.

At present, good progress is being made in the development of a new low-endurance drone system, the AN/USD-2. A medium endurance and a long-endurance drone system—the AN/USD-4 and the AN/USD-5 respectively—are progressing favorably. . . .

The varied problems of the combat surveillance field challenge our Army, our research institutions, and American industry itself. Solutions must be found. It devolves upon ACSA to develop the capability that will permit our Army to take full advantage of the systems of weaponry that have been produced in the last two decades. ACSA's present developmental program is designed to accomplish this task.

SYMPOSIUM

(Continued from page 9)

The incubation period of infectious diseases renders the agents thereof unsuitable for hand-to-hand encounter. A man can be an effective fighting machine throughout the incubation period of most infectious diseases. Secondly, the optimum effectiveness of BW would accrue from the possibility of covering very extensive target areas. Our most thoughtful attention must be given to the latter in planning for our defense."

In stating the required characteristics of a biological warfare agent, Dr. Fothergill noted that ". . . there are many microbiological agents that do not meet these basic requirements for BW purposes. Conversely, there are relatively few organisms that meet them . . .

"There are two general methods whereby agents might be applied to a target. The first, and most important of these is through the overt military delivery through weapons systems designed to create an aerosol or cloud of the agent. The second would be through covert methods . . .

"The possibility of the strategic coverage at long range of very extensive target areas is the major threat of BW to our nation. One of the major problems defensively would be the medical care of a large number of human casualties that might occur. It is mandatory that there be detailed advance planning for this eventuality at the community level in every city, village and hamlet . . ."

The types of agents for which we should plan defense, Dr. Fothergill continued, "can be divided into three broad categories for this purpose.

"First, we must face the threat of military delivery of truly exotic agents against our human and animal population and against our agricultural crops. Indeed, some of these possible agents . . . might be infectious for both man and animals . . .

"Secondly, we must face the threat of the use of agents of disease against man, animals or crops that had been eliminated from our country at the cost of a great deal of money and effort . . . If such diseases were re-established, their control again might be exceedingly costly . . .

"Thirdly, agents that are currently endemic or periodically epidemic might be used and some might be disseminated over areas where they are not now prominent . . . This might then re-infect animals in large areas that are now relatively free of such a disease.

"The possibility that mixtures of agents might be used should not be ignored. Some antianimal agent might be included with an antipersonnel charging . . .

"Our country is in a relatively favorable defensive position in anticrop warfare . . . Our agriculture . . . is very diversified and biological agents are highly specific. Actually, those countries that are generally dependent for climatic, agronomic or traditional reasons, on a single crop are the most vulnerable . . ."

Areas of defense preparedness in which more effort is needed were cited and discussed briefly by Dr. Fothergill. These included means for rapid detection of BW and early warning; specific identification methods; research to develop effective immunizing materials for prophylaxis. He also spoke of the importance of epidemiologic intelligence and the prompt recognition and reporting of anticrop and antianimal BW.

DEFENSE CHEMISTRY

(Continued from page 22)

does not take up water. Its copolymer is branching. (22)

Insulation that will protect missile components and launching pads for as much as one minute against temperatures ranging from 4,000°F to 6,000°F has worked satisfactorily at recent missile launchings. A striking example of the efficiency of the new insulation is in its proven ability to protect the hand of an operator holding a thin reinforced plastic panel on which a disk of copper was heated for one minute to 6,000°F by an acetylene flame. The insulating material is composed of such well known inorganic flame-proofing agents as boron and phosphate compounds bound with polyurethane. It is applied to a thickness of 50 mils (0.05 inch) in the form of a liquid, which sets and adheres to the surface to be protected. Under the intense heat the coating forms and swells with the formation of a ceramic-like crust, which lifts from the material below it. This is repeated several times until the changes have occured all the way down to the surface to which it was applied. Energy is also absorbed by the organics present in their decomposition and vaporization. In addition to aerospace applications, the new plastic coating might well serve as a fire barrier in planes and in industrial plants. (23)

Wooden ship hulls may be adequately protected against toredos and other marine-borers by canvas duck with adequate resin overlays. Neither glass fiber or silica have been found to be necessary for such protection, but resin impregnation and coating are essential. Much less resin is required by glass fiber to obtain a firm bonding to the wooden hull surface, but the glass cloth is subject to loosening after a much shorter period than the required two years of protection, so that borers enter around the edging as resin bonding weakens. Antifouling paint will not adhere satisfactorily to the overlays. (24)

Instead of making an opoxy resin by the condensation of a polyhydric phenol with epichlorhydrin, a new type of straight chain aliphatic epoxy resin is being made from olefins, which are plentiful and cheap. Combinations or mixtures of olefins may be used, as well as individual unsaturated hydrocarbons. The new resins are known as epoxidized polyolefins. They are unique in having reactive double bonds in the molecule, the point of unsaturation and the number of double bonds being controlled. Also these resins have epoxy groups only in terminal positions. The reactive double bonds permit curing with peroxide catalysts. Graft polymerization is possible with vinyl monomers. (25)

A recently patented process for epoxy resins eliminates handling peracetic acid, since this acid is formed in the process by the reaction between acetic acid and hydrogen peroxide in the presence of a sulfonic acid cation exchange resin. Relatively little of the catalyst is used, and the usual type may be thrown away. A specially prepared resin which is more highly cross-linked and kept free of metals can be recovered. This process, which is used in the new resins of the epoxidized olefin type, which are construction materials, protective coatings, and solid fuel binders, is also used in making epoxy fatty acid esters, which are already being extensively put into vinyl resins as plasticizers and stabilizers. (26)

FOODS

A process for regeneration of fresh flavor in foods has recently been announced, in which the Army Quartermaster Corps has had a considerable share. The process is particularly applicable to dehydrated foods, most of which lose a good part of their flavor as water is removed, but can be used with canned foods. The principle of this flavor-restoring method is the addition of an enzyme which will stimulate the action of dormant flavor precursors. With the enzyme these substances regenerate the original flavor of the fresh food. Such enzymes may be obtained from wasted parts of such foods as apple peelings, pea pods, and pineapple tops. The enzymes naturally present are largely destroyed in those processes that are necessary to decompose or destroy enzymes, bacteria, and other microorganisms that cause spoilage. With dehydrated foods, the enzymes are added to the dry material, and do not act until water is put in. With canned foods, the enzymes are included before sealing and final sterilization, the volatiles that are responsible for flavor being retained. The enzyme process is applicable to most fruits and vegetables, as well as milk, and light meats such as chicken and salmon. (27)

CHEMICAL ENGINEERING

A second process for conversion of sea water to fresh water employing freezing techniques has been approved by the Department of the Interior, and a contract is being let for a pilot plant. The first plan employing freezing is based on a vacuum process, while the new plant will employ flash evaporation of a volatile liquid such as butane, which is insoluble in water. A part of the water freezes and the pure water is obtained from the ice crystals that have been washed free of brine. Melting is accomplished by the heat of condensation of the butane. Several devices to separate ice and brine are to be tested. (28)

In addition to large premanent desalting installations producing pure water at a relatively low cost, the Army has long provided portable, trailer-mounted units employing vapor-compression methods. This equipment now in use is fabricated largely from copper-nickel alloys. Recently an aluminum unit has been developed which is lighter and has more density and uses less fuel. Final design is expected to be capable of producing 125 gallons per hour, and still be light enough to permit helicopter delivery. (29)

Maintenance of a reliable sprinkler system for extinguishing fires in polar regions has been insured by a solid-propellant pressurizer, said to be effective in temperatures as low as -65°F. Combustion gases of a double-base propellant expel the extinguishing liquid in the form of fine drops. A 300 gallon system equipped with a dual-loop automatic sprinkler is said to give adequate protection for two buildings, each 20′ by 48′, for five minutes. A supervisory gas pressure of 15 psi is maintained at all times, since an initial void of 25 gallons must be overcome. When pressure drops to 5 psi after sprinkling starts, a cartridge is fired and brings pressure up to 100 psi in a few seconds. Thereafter another cartridge is detonated each time pressures in the tank and loop fall below 35 psi. Four charges will give fire protection until all of the 300 gallons of extinguishing liquid have been expended through any or all of the sprinkler heads. The system has been developed for the Navy. (30)

The field of extremely high pressures has been greatly advanced by cutting down the size of equipment required. This has been accomplished in the first place by surrounding the object to be compressed with volcanic lava, which is solid when cold but which liquefies under heavy pressure. This liquid lava also serves to insulate the tungsten carbide anvils from excessive

heating during the few minutes of the compression operation. Electric tabs at the sides of the specimen are the sources of heat. The real secret of reducing the size of the equipment lies in employing four tungsten carbide anvils of pyramidal shape, the apex of each being cut off so that the area at the inner end of the pyramid is about 1/50 of that of the outer end. The anvils are enclosed in rubber and the assembly is suspended in water in a sphere. A pressure of 30,000 psi on the larger surface becomes 1.5 million psi at the point of application to the specimen. So far the process has been limited to gem production, some $25 million being the figure paid for synthetic diamonds in 1959. Several of these machines are research models, from which a variety of results may be expected. It has been pointed out that simultaneous compression and heating of metals can increase their tensile strength from 100 to 10,000 times without sacrifice of ductility; new alloys and compounds can be made under high pressures; metallic powders may be compressed to 99.8% of their theoretical density as compared with 93% by present methods; and the electrical conductivity of metals may be increased four fold under 1.5 million psi. (31)

INSTRUMENTATION

The high point in the field of mass spectrometry has been reached by the construction of the largest equipment of this type in the world. At the Argonne National Laboratory, a 25 ton mass spectrometer is now being put through its paces, with final focusing and calibration. The impressive dimensions of this instrument are: radius, 100 inches; length, 40 feet; height, 6 feet. Transmitting more than 95% of the ions from the source, it has a resolution by which atoms differing from each other by one mass unit in 10,000 can be distinguished. The structure of the mass spectrometer is described as being horizontally a backward letter S. The sample goes in at one end of the S, where the atoms are charged. Acceleration is accomplished at 50,000 volts, the ions moving in a vacuum of 10^{-6} mm of mercury. Sorting is done by a 14 tone permanent magnet with a stable field of 2,00 gauss. In the collector there is an electron multiplier unit capable of registering a single ion. Planned uses include uranium isotope concentrations in meteors, occurence of curium-247 in nature as a key to the origin of elements, more accurate half-life measurements, concentration measurements of isotopes of heavy elements, studies of atomic nuclei such as creation under bombardment, and masses of various species. (32)

An ultrasonic flowmeter has been recently announced, in which the deflection of an ultrasonic beam is measured as it is shot across the flow of liquids. Differences are between receivers placed on the outside of the pipe or conduit on either side of the transducer producing the waves, which is also outside the pipe. The ultrasonic beam originates in a piezoelectric transducer, and there are crystal receivers. So far pipes are limited to such metals as bronze, brass, cast iron, and stainless steel. Water and sewage flowmetering operations are the major probable users of such ultrasonic equipment, but employment with other liquids will depend on temperature and liquid viscosity. (33)

The vapor source strength of mustard-contaminated surfaces is now being measured by a device developed by the Navy, in which high-sensitivity results from continuous sweeping of the surface suspected of being contaminated with a current of air. It consists of a two compartment metal cup, with one part containing an activated charcoal filter. Air is drawn by means of a rubber bulb at a fixed rate, and in the desired volume, through the charcoal and over the surface being investigated. (34)

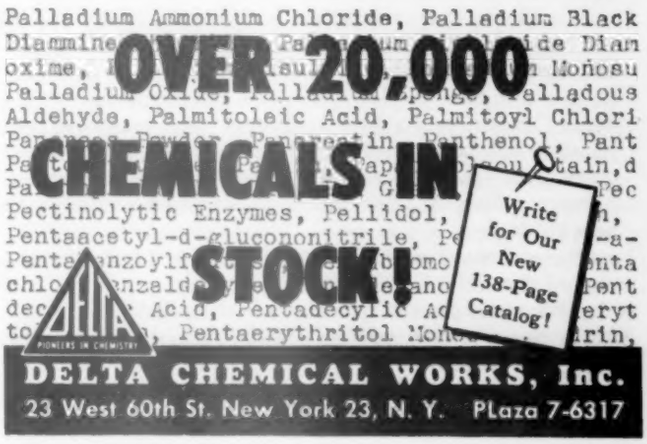
References

1) Chem. Week 2/20/60, p. 21
2) Chem. & Eng. News 3/21/60, p. 55
3) Chem. & Eng. News 2/22/60, p. 59
4) Chem. Week 3/26/60, p. 75
5) Chem. & Eng. News 2/8/60, p. 40
6) Chem. & Eng. News 12/28/59, p. 34
7) Chem. & Eng. News 3/7/60, p. 51
8) Chem. Week 3/5/60, p. 95
9) Chem. & Eng. News 3/28/60, p. 47
10) Off. Tech. Serv. 60-67, 3/14/60
11) Chem. & Eng. News 3/28/60, p. 30
12) Chem. Eng. 2/8/60, p. 60
13) Chem. Week 3/12/60, p. 43
14) Chem. & Eng. News 2/29/60, p. 46
15) Chem. & Eng. News 3/7/60, p. 51
16) Chem. Week 3/12/60, p. 95
17) Chem. Week 2/27/60, p. 23
18) Chem. Eng. 3/21/60, p. 78
19) Chem. Week 2/6/60, p. 41
20) Chem. & Eng. News 1/25/60, p. 62
21) Chem. Eng. 3/21/60, p. 86
22) Chem. & Eng. News 2/15/60, p. 67
23) Chem. & Eng. News 3/28/60, p. 54
24) Off. Tech. Serv. 60-65, 3/14/60
25) Chem. & Eng. News 2/8/60, p. 50
26) Chem. & Eng. News 2/8/60, p. 48
27) Chem. & Eng. News 2/15/60, p. 66
28) Chem. & Eng. News 3/7/60, p. 35
29) Chem. & Eng. News 2/15/60, p. 57
30) Off. Tech. Serv. 60-65, 3/14/60
31) Chem. Week 3/5/60, p. 36
32) Chem. & Eng. News 1/25/60, p. 49
33) Chem. Week 3/19/60, p. 50
34) Off. Tech. Serv. 60-28, 1/25/60

SCHOOL

(Continued from page 14)

One final word remains to be said about one of our most important functions here at the School: the critical one of doctrine development. Our Corps has always been acutely aware of the importance of research and development, and has given it strong support. But after materiel has been devised and developed there must be devised and developed a doctrine for the use of the materiel—tactical and logistical doctrine. Doctrine is a basic need because until an Army is trained in the method of tactical use and the procedures of support and supply, the weapon is useless. Doctrine develops naturally and inevitably at service schools—the faculty and the students see the gaps and suggest the possible ways to bridge them. Unfortunately, after the gap has been seen and a solution has been proposed, there is a long and tedious process to go through—coordination at a dozen levels, adaptation to existing comparable doctrine and to other existing materiel. Here, we feel, is the area of real challenge, the area where the answers are not cut and dried, and the area where the School is particularly well equipped to make a major contribution.



NUCLEAR ENERGY INDUSTRIAL WASTES

Condensation of an address to the Second Sanitary Engineering Conference on Radiological Aspects of Water Supplies, at University of Illinois, Urbana, Illinois, January 27, 1960, by—

JOSEPH A. LIEBERMAN*

Chief, Environmental & Sanitary Engineering Branch
U.S. Atomic Energy Commission

THE MANAGEMENT of radioactive wastes which includes their handling, treatment and disposal is a general problem whose thread runs through the complete fabric of nuclear energy operations . . .

In the peaceful day-to-day application of the benefits of nuclear technology, the disposal of radioactive wastes potentially represents perhaps the major "non-beneficial" effect on the public and its resources. Accordingly, this aspect of nuclear energy operations is of direct interest and concern to the public . . .

Radioactive wastes in either gaseous, liquid, or solid forms are evolved in essentially all operations associated with nuclear energy facilities beginning with mining of ore, through feed material production, reactor operation, chemical reprocessing of reactor fuels and a wide variety of uses of radiation in medicine, agriculture and industry.

Because of the nature and characteristics of the radioactivity involved, including, in specific instances, long effective life, its ability to damage human tissue, and its potential danger as an environmental contaminant, the safe handling and final disposal of radioactive wastes are integral and important aspects of nuclear operations. . . . More money probably has been spent, and more scientific and technological effort concentrated on facilities, operations and research with regard to this industrial waste, than on any other industrial contaminant we have known. At the present time at Atomic Energy Commission installations, there is an investment of approximately $200,000,000 in facilities for the handling, treatment and disposal of the wastes, while the estimated annual operating cost for these facilities is approximately $6,000,000.

. . . While it reasonably can be argued that no industry can be considered a mature segment of our economy unless and until it handles and disposes of its wastes in an acceptable manner, there is sufficient basis for the belief that the nuclear energy industry can develop in a rational way without being "bottlenecked" by its own wastes. This conviction should not, however, carry the implication that specific answers are immediately available for all problems in this field . . .

In order to keep the public and others having special interest in the treatment and disposal of radioactive wastes informed, public hearings were held last year before the Special Subcommittee on Radiation of the Joint Committee on Atomic Energy. The record of this hearing has been published in 5 volumes which cover more than 3,000 pages and represents the most comprehensive collection of technical information available on this subject.

The summary of the results of these hearings concluded that:

1. The management or disposal of radioactive wastes is not a single problem with a single solution. It varies widely, depending . . . on radioactive materials involved, and . . . the . . . environment in which it must be considered.
   The wastes can be considered in two classes . . .: they are "low-level" and "high-level" wastes. "Low-level wastes" have a radioactivity concentration in the range of one microcurie per gallon. By way of contrast, some "high-level wastes" have concentrations of hundreds or thousands of curies per gallon—and thus can be more than a million times more concentrated than "low-level wastes." In terms of volumes of wastes generated, billions of gallons of low-level wastes are produced each year, . . . whereas the volume of high-level wastes produced is much more limited. Since the beginning of the atomic program, 65 million gallons of high-level wastes have accumulated, all contained in underground storage tanks.
2. According to scientific experts who testified, . . . radioactive waste management and disposal practices have not resulted in any harmful effect on the public, . . . Extensive monitoring programs have shown that concentrations of radioactivity released to the environment are well within established permissible limits. Detailed monitoring and control must be maintained . . . on a continuing basis for generations.
3. Low-level wastes are being dispersed into the air, ground and water under careful control and management with or without treatment as required. The problem may be expected to increase as the nuclear-power industry increases . . .
4. The final disposal of high-level wastes associated with the chemical reprocessing of irradiated nuclear fuels represents an aspect of the problem that, while safely contained for the present and immediate future, has not yet been solved in a practical, long-term engineering sense at the present time. The practice today is to reduce high-level wastes in volume, if possible, and to contain or hold them in tanks. It was the consensus that tank storage is not an ultimate solution. . . . Although apparently feasible solutions to the problem of ultimate disposal of high-level waste are in various stages of development, at least several years of . . . testing will be required before . . . practicality can be demonstrated.
5. It will always be necessary to use the diluting power of the environment to some extent in handling low-level waste. Present dispersal methods have been demonstrated to result in concentrations well below established permissible limits. The cost of "absolutely" processing or containing all these large volumes would be prohibitive. . . .
6. Suggestions for final disposal of high-level wastes include:
   a. Conversion to solids. . . .

---

* In collaboration with David C. Costello, Jr., Sanitary Engineer, Environmental & Engineering Branch.

b. Storage of solids in selected geological strata with major emphasis on salt beds.
c. Disposal of liquids into geological strata—either deep wells or salt beds, and—
d. Disposal of liquids or solids into the sea.

Although a number of possibilities were described, . . . the conversion to solids and storage . . . in salt formations seemed to be the most favored at this time. The least favored was disposal of high-level wastes in the sea.

7. Some radioactive wastes have been disposed into the sea, but it should be emphasized that these were of a low-level, solid, packaged variety. Disposal of high-level chemical reprocessing wastes at sea is not contemplated by the Commission at this time.
8. It was generally agreed that separation of specific fission products (such as Strontium-90 and Cesium-137) only for their industrial utilization would not affect appreciably the waste disposal problem.
9. The long-term responsibilities . . . must be borne by . . . various levels of Government, but primarily the Federal. However, industry, under proper regulations, can, and must ultimately assume greater responsibilities . . . in . . . actual physical handling and disposal operations.
10. International aspects of the problem are important, . . . particularly . . . disposal into the seas and operation of nuclear-propelled vessels and aircraft. It is essential that competent international agencies attack these problems at an early date. . . .
11. Initial waste disposal costs, though large in absolute numbers, appear to be a relatively small fraction of unit nuclear-power costs and within the realm of economic practicality. It must be emphasized that these economic conclusions are, at the present time, based on calculation rather than on demonstration. . . .
12. From an environmental health and safety standpoint, the types of potential waste-management problems which will require continued efforts . . . in the future are as follows:
    a. Controlled releases of low-level wastes under careful supervision. . . .
    b. Possible leaching of small fractions of high-level wastes from underground storage sites—and
    c. Accidental, irregular releases from nuclear energy operations.

. . . it has been estimated during the hearings that it would be 20 to 25 years before the national waste storage demand for high-level wastes from nuclear power would equal the present volume of about 50 million gallons in storage at Hanford, Washington. With new chemical processing and waste treatment systems, there are reasonable prospects for reduction of these volumes. Vigorous efforts should be continued . . . to find a "foolproof" method for fixation of high-level wastes into solids in less than 20 to 25 years.

The technology for control of low-level wastes appears to be sufficiently straightforward so that the contribution of radiation exposure from waste-dispersal operations can continue to be a small percentage of the total exposure of man from all radiation sources. Nonetheless, care should be taken to control buildup of contaminants in individual links of the food chain from particular environmental concentration factors that might prevail.

The International Commission on Radiological Protection has recommended that maximum permissible radiation exposure for the population at large from environmental contamination of all sources should be about one-third of the average radiation exposure from medical sources. Testimony . . . indicated that it is not expected that waste-disposal activities alone will use up all of this in the foreseeable future.

It is important to emphasize that the management of radioactive wastes, from an environmental and engineering standpoint particularly, cannot be considered as a single problem with a single, optimum solution. The great variation in the characteristics of the waste from various processes, . . . and location of the nuclear facility are all important in assessing the significance of the hazard. . . .

The major objective of waste management is control over the radiation hazards. Obviously, this involves control over the mobility in the environment of the waste products themselves. This introduces the two basic waste disposal concepts. . . . The radioactive materials may be permanently confined or isolated within restricted areas, away from people and their resources. This is the concept of "concentrate and contain." On the other hand, the radioactivity may be irreversibly reduced to safe levels by dilution in nature. This is the concept of "dilute and disperse." For example, . . . certain types of laboratory liquid wastes at radiation levels of only a few times greater than drinking water standards may be disposed of under the latter concept. On the other hand, highly active liquid wastes . . . must be handled under the former philosophy. For all practical purposes, the wastes from chemical processing contain, by far, the greatest concentrations and total quantities of radioactivity and constitute the bulk of the long-term technological problem of waste disposal. . . .

Characteristics of gaseous and/or airborne particulate wastes vary widely. . . . In gaseous form they may range from rare gases, difficult to remove, such as Argon (A^{41}) from aircooled reactors, to highly corrosive gases such as hydrogen fluoride (HF) from chemical and metallurgical processes. Particulate materials (aerosols) may be organic or inorganic and range in size from less than 0.05 microns to 20 microns. The smaller particles originate from the metallurgical fumes caused by oxidation or vaporization. The larger particles may be acid mist droplets which are low in specific gravity and may remain suspended in air or gas streams for longer periods. An outstanding feature of air cleaning requirements for many nuclear energy operations results from the extremely small permissible concentrations of various nuclides in the atmosphere. Often removal efficiencies of the order of 99.9 percent or greater for particles less than 1 micron in diameter are necessary. These criteria are much more stringent than heretofore encountered in industrial hygiene engineering. Atmospheric diffusion and dispersion must be quantitatively evaluated so these factors can be utilized in establishing the design criteria for air cleaning systems.

Solid radioactive wastes such as non-usable contaminated equipment, non-recoverable scrap, and contaminated trash . . . do not constitute a serious technical problem. However, if inadequate provisions are made for their proper handling and disposal, they could be a distinct nuisance and, . . . even a hazard. The levels of radioactivity here vary from a few times background to quantities requiring substantial shielding or remote handling. The engineering of systems for handling and disposal of solid wastes has been relatively simple. Burial of such wastes under known controlled conditions and, in specific instances, disposal at sea have successfully and safely handled the problem.

In the United States, established burial grounds for solid radioactive wastes exist only at large atomic energy production and development sites such as Oak Ridge, Idaho, Hanford, Savannah River Plant and Los Alamos. These facilities are in isolated areas with detailed geology and hydrology generally favorable to burial ground location. Within AEC, the operating establishments other than those noted above, . . . are in relatively small areas near densely populated sections with perhaps less favorable geology and hydrology. In these cases, the general procedure is . . . to ship to one of the established burial grounds for final disposition.

The radioactive material involved in AEC sea disposal operations off both the Atlantic and Pacific Coasts is of a relatively low or intermediate level. The wastes . . . are packaged within concrete in 55-gallon drums or in preformed, reinforced concrete boxes before disposal.

Since 1951 the AEC has disposed of less than 8,000 curies (at the time of disposal) into the Atlantic Ocean. . . .

In the Pacific Ocean, disposal operations began in 1946 and since then approximately 14,000 curies (at the time of disposal) . . . have been disposed off San Francisco coast in one area. Also . . . about 60 curies . . . have been disposed in a second Pacific Ocean area.

All of these disposals are in depths of water of a thousand fathoms or greater. The radioactivity content ranges from about one-half a millicurie to 1.5 curies per drum for the solid wastes—with most around one-half curie or less—and from one-half millicurie to 1.5 curies per drum for the solidified liquid wastes at the time of disposal. It is our belief that these sea disposal operations are being carried out in a manner that is safe and adequate. . . .

. . . We would cite the recent report of the National Academy of Sciences-National Research Council (Publication 655, "Radioactive Waste Disposal into Atlantic and Gulf Coastal Waters"). The marine scientists who prepared this report indicated . . . that it would be feasible to dispose safely solid, packaged wastes of the type previously described at several inshore, shallower water locations along the Atlantic and Gulf Coasts. This, however, was only a feasibility study and actual disposal operations at these sites are not currently planned.

Liquid radioactive wastes are evolved in all nuclear energy operations. . . . As previously indicated, it is important to differentiate between what we call a "high-volume, low-level" waste; for example the contaminated laundry waste which may contain say a few microcuries of radioactivity per gallon and a "low-volume, high-level" waste resulting from chemical processing of nuclear reactor fuels which may contain up to 1,800 or more curies per gallon. . . . The engineering problems of handling and disposing of these two categories are entirely different.

During the milling operations of the nuclear fuel cycle, liquid effluents are evolved that present potential stream pollution problems due to the dissolved radium in the effluents. Present indications are that the major portion of the radium found in the streams is associated with the suspended solids discharge and is amenable to control by available waste treatment methods. . . . The AEC in cooperation with the U.S. Public Health Service is engaged in field studies that will result in an industrial waste guide for the uranium milling industry.

Liquid wastes with low concentrations of radioactivity originate in laboratory operations where relatively small quantities of radioactive materials are involved, ore and feed material processing, the normal operation of essentially all reactors, and also chemical processing plants. These low activity wastes, under proper environmental conditions, are susceptible to either direct disposal to nature or to disposal following minimum treatment as co-precipitation, ion-exchange, biological systems and others. Because of their relatively high volume, total costs for treatment may be substantial. Therefore, to the extent that it is *absolutely safe*, use is made of dilution factors that may be available in the environment and that can be assessed quantitatively. This points up the importance of proper site selection and quantitative environmental data for nuclear energy facilities.

The routine operation of power reactors produces relatively small quantities of low-level wastes. The Shippingport Reactor (PWR), as an example, uses recirculated pressurized water as reactor coolant. Activity builds up in the coolant due to activation of corrosion products, formation of tritium from lithium hydroxide used to raise the pH for corrosion control, and from possible fission products introduced by fuel ruptures. To limit the buildup of these contaminants, the coolant is continuously purified by circulating a portion of it through a bypass demineralizer.

It is significant to note that the first *year* of plant operation, the total quantity of radioactivity discharged (into the Ohio River) was about 0.04 curies of mixed isotopes and about 50 curies of tritium. Both of these quantities are much less than the permissible discharge for a single *month*.

High-activity liquid wastes associated with the chemical processing of reactor fuels constitute the bulk of the technological problem of waste disposal. It should be pointed out clearly that these wastes do not come directly from the reactors themselves, although under the improbable conditions of reactor malfunction some high-activity waste material may result. In the future, such wastes also may be associated with certain types of homogeneous reactors to the extent that continuous fuel processing right at the reactor is envisioned. At present (and for the immediate future), chemical processing plants are essentially the sole source of the wastes.

Chemical processing of reactor fuels is done to separate and recover unfissioned or unburned fuel from the desired product and the wastes. At the present time, this means, for the most part, separating uranium, plutonium and fission products.

The quantity of high-level wastes generated depends largely upon the chemical and metallurgical characteristics of the fuel being processed and the specific nature of the chemical process involved. It may range from 0.1 gallons to perhaps 1.5 gallons per gram of uranium processed. On a total volume basis it is estimated that we have to consider waste production rates on the order of tens of millions of gallons per year.

From the viewpoint of the environmentalist, it is perhaps misleading to apply the term "disposal" to current methods of handling highly radioactive liquid wastes. With only minor exceptions, these wastes are not "disposed of" but are stored in specially designed tanks. Since the effective life of the fission products . . . may be measured in terms of hundreds of years, it is apparent that tank storage is not a permanent, long-term answer. . . . The capital cost of tank storage varies from about $0.30 to roughly $2.00 per gallon capacity.

Based on various estimates on the growth of our nuclear power industry, one can calculate the total

cumulative quantity of radioactivity to be disposed of in the future. Depending upon whose nuclear energy growth estimates are used, the radioactivity accumulations range from about 3 billion to 20 billion curies in 1965 to about 400 billion to 1,000 billion in the year 2000. Now, when one considers the generally extremely low maximum permissible concentrations of radioactivity in air and water, it becomes apparent that there is not enough dilution available in nature to enable any practical, continuing dispersal of these wastes into the environment. The application of the dilute and disperse philosophy does not appear to be a very good possibility.

A possible exception, but somewhat academic at the present time, is disposal at sea. Most proposals for this approach envision the utilization of the vast dilution volumes in the oceans as the primary basis of the operation. However, from an oceanographic viewpoint, the quantitative assessment of dilution, diffusion or transport in large water masses of the ocean is rather difficult. Also, the degree of reconcentration of radioactivity in marine life and its long-term ecological implications is surrounded by considerable uncertainty at present. This existing lack of quantitative oceanographic information, when added to the substantial problems of . . . the actual placing of these materials in specific ocean depths, lead one to rather negative conclusions regarding the disposal of significant quantities of high-level wastes at sea.

The AEC is carrying out an extensive research and development program in the field of waste management. . . .

A substantial part of present development efforts in low-level waste management relate to geophysical and environmental aspects of dispersal operations . . . First . . . a quantitative evaluation of the specific behavior of the atmosphere, hydrosphere and lithosphere at the location involved is imperative if rational engineering criteria for waste facilities and their performance are to be established. Second, the environmental aspects of the site of the nuclear plant as they relate to effluent control, potential hazards and plant design should be considered early in site selection.

The use of surface waterways for dispersal of certain low-level liquid wastes is actively practiced at a number of AEC operated installations in the United States. The utilization of available dilution factors in these waterways is predicated upon a quantitative determination of specific dilution and/or concentration phenomena. . . .

In general, the operating philosophy that prevails is that such environmental dilution factors may be utilized in waste dispersal if it can be demonstrated (by studies as indicated above) that these practices can be carried out without deleterious effect on man or his resources.

A similar approach applies to the dispersal of low and intermediate level radioactive wastes to the ground. Some factors that must be evaluated include the chemical (and radionuclide) composition of the waste, the adsorption and ion exchange capacities of the receiving earth materials, the ground water hydrology of the area involved, and utilization of these ground water resources. There are a number of specific questions which have not yet been answered as precisely as one would like in an engineering sense. Such phenomena as dilution or diffusion of waste streams in moving ground water have not been completely described. . . .

Development activities directed toward establishment of systems for ultimate disposal of high-level wastes are being pursued along the following lines:

For your chemical needs

call on Hooker

Benzoyl Chloride	Phosphorus
Benzyl Chloride	Phosphorus Chlorides
Carbonate of Potash	Phosphorus Sulfides
Caustic Potash	Potassium Chlorate
Caustic Soda	Sodium Benzoate
Chlorine	Sodium Chlorate
Chlorobenzenes	Sodium Hypophosphite
Chloroparaffin	Sodium Phosphates
Chlorotoluene	Sodium Sulfhydrate
Hexachlorocyclopentadiene (C-56®)	Sodium Sulfide
Muriatic Acid	Sulfur Chlorides
Phenol	Sulfuryl Chloride
Phosphoric Acid	Thionyl Chloride
	Trichlorethylene

For descriptive list of Hooker products, write for General Products List No. 100.

HOOKER CHEMICAL CORPORATION

1001 Forty-seventh Street, Niagara Falls, N. Y.

HOOKER CHEMICALS PLASTICS

Sales Offices: Buffalo Chicago Detroit Los Angeles New York Niagara Falls Philadelphia Tacoma Worcester, Mass.
In Canada: Hooker Chemicals Limited, North Vancouver, B. C.

With regard to treatment and processing, there has been a substantial investigative effort on the fixation of radioactive material in chemically inert solid media. The objective is to so convert the wastes into a solid, nonleachable material that they may be permanently stored, that is, disposed in specific environments with negligible long-term hazard. Two general schemes for accomplishing this objective have been under development at several AEC and university laboratories.

One involves the conversion of the highly radioactive liquid wastes to a solid oxide form by heating in some kind of liquid-solid contactor. . . .

The other general scheme involves incorporating the radioactive material either physically or chemically in clays, glasses, or synthesized crystal minerals such as feldspar or micas. These two general ideas can fit together in that the solid oxide may be used as a starting material in a further fixation system, or . . . may be put through a leaching step to remove the soluble radioactivity, and the leach solution can then be fixed in another solid material.

Enough laboratory work has been done to indicate the technical feasibility of several such systems. Engineering development is farthest advanced at the Idaho Chemical Processing Plant where a fluidized bed technique is being utilized to convert the liquid wastes to a solid oxide. At Idaho the construction of a 60-gallon per hour prototype development unit is well along and the unit will go into "cold" operation in the near future. . . .

The possibility of direct disposal of high-level wastes —the wastes associated primarily with the chemical processing plants—into selected geologic formations has been under active consideration for about the past 2½

(Continued on page 36)

INTELLECTUAL PROPERTY

(Continued from page 18)

conclusion that the parties were conspiring to prevent grant of licenses to others.

Royalties are a subject of negotiation, and payment agreements, on any reasonable basis, are not ordinarily disturbed. It is not even essential that payments be based on actual use of the patented invention. Thus, when patents were so numerous as to make it difficult to determine whether all products were actually covered, payment of the royalties based on the total of a defined class was approved. But a requirement for payment of royalties on clearly unpatented products was disapproved.

A license agreement may not properly prevent the licensee from dealing in unpatented goods or those of the patentee's competitors.

Misuse (Control of Unpatented Supplies)

One of the most perplexing questions in either patent law or anti-trust law is that of the extent of permissible control over unpatented supplies or components used in practice of patented inventions. Often concerns in the business of making and selling a particular kind of supplies will seek to expand their markets by developing new uses for the supplies. If patents are obtained on such new uses, they will be likely to cover combinations which the patent owner may not be able to assemble but which include the unpatented supplies as components. In these situations, the patent owner naturally expects to be able to use the patent to obtain at least some competitive advantage in the sale of the supplies.

The courts have dealt with this problem for many years and have made decisions stating more and more definitely that a patentee is not entitled to be free from competition in the supply of unpatented components. These decisions carefully refrained from referring to the anti-trust laws, and were based on the concept that it was inequitable for a patentee to use his combination patent to control sales of the unpatented supplies, and that the courts would not aid in the enforcement of a patent as long as this misuse continued. Finally, the Supreme Court completely changed the asserted basis for the decisions and declared this practice to be a violation of the anti-trust laws.

In the case in point, the supplies in question were specially designed items, not patented as such, but only as components of a combination, and not useful for any purpose except as components of the patented combination. The decision led to a change in the statute.

The present patent law specifically declares that supply of a non-staple component which is not capable of substantial non-infringing use is contributory infringement, and also states that it is not misuse of a patent to enforce it against a contributory infringer. The precise effect of this statute is not altogether clear, but it would seem to limit the applicability of the "misuse" ruling to situations in which the unpatented components or supplies are staple commodities capable of various uses. Consequently, the owner of a combination patent, whose business is limited to supply of components, may be able now to prevent others from competing in supply of a component of special design.

Conversely, it would be unwise for an owner of a combination patent involving staple components to attempt to monopolize supply of the staple components to persons using the combination. The only completely safe way to benefit from ownership of such a patent is to engage in the business of making the entire combination, or to license those who do make the combination on some suitable royalty basis.

Package Licensing

Industrial concerns often accumulate groups of patents related to one another in such a way that a particular product or its production may be covered in its various parts or aspects by several or many of the patents. In such situations, licensees naturally desire a license under all patents covering the licensed product in any way.

A patent owner also may wish to obtain income from licensing a group of patents, but a prospective licensee may decide that he needs a license under only one or a few of them, and that it would be disadvantageous to have a license, with accompanying commitments as to validity, payment of royalties, etc., under patents which he may regard as invalid or at least not pertinent.

A refusal to grant any other than a "package license" under an entire group of patents was condemned. But offering of a "package license" is not objectionable where there is no refusal to grant licenses under individual patents.

Copyrights

In copyright licenses, as in patent licenses, anti-trust problems can arise, but the complexities are less because a large proportion of all copyright contracts are relatively simple agreements between authors on the one hand, and publishers of books and magazines or producers of dramatic programs on the other hand. Copyright agreements usually follow fairly well understood forms and practices. The most outstanding problems are those analogous to the "package license" under patents.

The right to exhibit motion pictures is acquired by a copyright license which specifies the extent of permitted exhibition and the compensation to be paid. The owners of motion pictures, in order to profit from less popular as well as from the most desirable productions, engaged in "block booking," which required exhibitors to take unwanted motion pictures in order to get those actually desired by them and their customers. Such compulsory block booking was held to be illegal.

A similar problem arose in connection with performance of musical compositions over the radio or in places of entertainment. The music publishers instituted a licensing system charging a flat fee for the privilege of performing any desired copyrighted music. This system was approved, as long as the right to a license for individual selections was available on a reasonable basis.

Proprietary Data (Know-How)

Rights to proprietary data—know-how or trade secrets—can impinge on anti-trust restrictions when conveyed from one company to another. When such conveyance is ancillary to a patent license, the same problems arise as with licenses generally, except that more care is required because proprietary data do not have the status of justification by statute that can be asserted for patents.

Conveyance of proprietary rights to competitors, in this country, occurs to some extent, but there is a greater incentive to make agreements for conveyance of proprietary data to manufacturers in other countries, and some of them have been the subjects of anti-trust litigation.

In a famous case, foreign companies were supplied with manufacturing data of an American company, and they agreed not to sell any products except under the American company's brand, and to sell at prescribed prices except within their allotted territories. Dominance was clearly shown, even though patent control

had expired. The agreements were held to be prohibited restraints of foreign trade (that is, trade between the United States and foreign countries) because of the price fixing and allocation of markets.

It is beyond question that a manufacturer may establish branch factories and sales branches and may instruct them on what to make, what prices to charge, what territories to serve, and the like, without fear of violating the anti-trust laws. One cannot conspire with oneself. The fact that some of the branch operations, either in this country or in a foreign country, may take the form of wholly-owned subsidiaries should make no difference, as it is the fact of ownership and control that is important rather than the form of organization. Consequently, there should be no hesitancy about making suitable arrangements for allocating business among completely-owned branch or subsidiary operations.

Different considerations apply when there is significant minority ownership, as it is possible for agreements with partly-owned subsidiaries, if of a kind which might restrain trade, to be regarded as made for the benefit of the minority owners, and to be prohibited.

If there is no subsidiary relation, because of absence of stock control, agreements should be governed by the same rules as those made with complete strangers.

In agreements for conveyance of proprietary data to a competitor in this country it is preferable for the agreements not to be exclusive. But in agreements with foreign concerns it is common to stipulate that the same data will not be supplied to others in the same country, since such a stipulation can hardly be regarded as a restraint of trade of the United States. It is also proper to require the recipient to keep the data confidential and not to use the data except in his own country. Care must be taken, though, in not placing undue restrictions on sales or products.

An exchange of proprietary data is more likely to be troublesome than a one-way conveyance. An undertaking by two principals, one a foreign concern, to exchange rights and the joint ownership of operating companies in other countries were both held to be illegal.

Trademarks

Until recently, trademarks were regarded as inseparable from the goodwill of the user, and therefore as not capable of being licensed, except in the situations involving certification of quality or origin, or membership in an organization. It is generally recognized now that legitimate business purposes are served by licensing use of trademarks, as long as there is no deception of purchasers and proper control is maintained by the trademark owner. In fact, licensing is provided for in the federal trademark statute.

Certification marks are those which certify the maintenance of a prescribed standard, such as the famous "Sanforized" mark on cotton garments. A curious limitation of the trademark statute is that registrations of certification marks may be cancelled if the owner of the registration deals in the goods bearing the cerification mark, or if the owner refuses to certify the goods of anyone who maintains the prescribed standards. No sound basis for these restrictions is apparent, and their result is simply that those who wish to do business in one of these ways do so without benefit of a United States trademark registration, relying on common law rights for their protection.

The trademark statute expressly provides that a trademark registration, which can become conclusive evidence of the owner's exclusive right to use the trademark, will not have that effect if "the mark has been or is being used to violate the anti-trust laws of the United States." This has been stated to amount to a possible defense in an infringement suit, but it clearly does not go that far. It is merely a rule of evidence.

In general, trademark licenses are no different from other agreements in their relation to anti-trust laws. Thus an agreement requiring use of a trademark and at the same time prohibiting use of the trademark in certain territories was held to be a prohibited division of markets.

A special situation concerning imported goods has been mentioned as a possible limitation of the anti-trust laws. The statutes prohibit importation of goods bearing a copy of a trademark, especially when the trademark is registered and the registration certificate is filed with the customs authorities. These statutes have been interpreted as permitting exclusion of genuine foreign merchandise imported by anyone other than the concern owning the trademark rights in the United States. Recently, attempts have been made to restrict or terminate this provision.

Another area in which changes may occur is that of "fair trade" price fixing. The laws permitting a supplier of branded merchandise to stipulate a minimum resale price have been held to be invalid in many states. There are consequently active attempts to formulate more effective laws to permit price fixing. The desirability and probable enforceability of such legislation are both quite controversial.

SUMMARY

Anti-trust investigations and suits are so disruptive of normal business and consume so much time of the people involved and of their attorneys that anti-trust proceedings are to be avoided wherever possible.

The boundary between permitted and prohibited practices is often elusive. Some actions are considered, in themselves, to be violations. Others are held to be violations of the law only when monopoly results. Moreover, actions which are innocuous when they occur alone may represent a prohibited restraint of trade when they are combined.

Competent legal advice should be obtained whenever there is any question as to whether an actual or proposed action is permissible under the anti-trust laws. There are nevertheless some rather simple principles which will insure safe guidance in exploitation of intellectual property rights to the fullest possible extent to the benefit of all.

1. *Make Licenses Available*

There must always be some one person or concern who has the unrestricted right to grant licenses, even though he may choose not to exercise that right.

2. *Retain Control of Licensing*

The owner of a patent or other intellectual property right (this includes an exclusive licensee since he is effectively the owner) must make his own decisions as to who is to be licensed, as to terms of licenses, etc. No restrictions should be placed on the freedom of the owner to make these decisions.

3. *Avoid attempt to protect a licensee's business*

Price fixing of patented products and certain other restrictions in licenses have been approved as protection for the business of the patent owner. These restrictions should not be used to protect a licensee's business, especially not when the patent owner has no business of his own to protect.

4. *Avoid negative covenants in licensing*

A license, although basically a waiver of a legal right to exclude, may be considered as a positive grant of rights. The grant may be as broad or narrow as the owner chooses to make it. But once the scope of the

grant has been defined, it is hazardous to place in a license document any separate covenant restricting operations of the licensee.

5. *Avoid exchange of future rights*

When existing rights are licensed, it is proper to provide for an ancillary exchange of similar rights for improvements for a limited future time. An agreement which is primarily an exchange of future rights is hazardous.

NUCLEAR WASTES

(Continued from page 33)

years. The feasibility, practicality and safety of such systems will be demonstrated only after extensive laboratory and field experiments which are just now being initiated. . . . Of the geologic formations proposed for this purpose in the United States, which include salt structures, deep synclinal basins, impermeable shales and certain deep porous formations, disposal into prepared cavities in salt is the most advanced in programming. . . .

At the present time it would appear that one optimum solution to the problem of final disposal of highly radioactive liquid wastes would include the conversion of the waste into a solid, preferably inert, form and the long-term, essentially permanent, storage of these solids in a specially selected geologic formation such as a salt bed. As the degree of inertness of the solid material is increased, the requirements for the geologic formation become less restrictive. Interim tank storage would be an integral part of such a system.

Intimately related to progress in waste management are substantial improvements in chemical reprocessing that have led to reduced waste volumes, reduction of non-radioactive dissolved solids in the wastes and other improvements. . . . This attack on the problem at its source represents an important contribution in the waste field. . . .

NURSING OF GAS CASUALTIES

ARMY CHEMICAL CENTER, MD.—Dr. Milton H. Joffe, a Chemical Warfare Laboratories physiologist, addressing the national defense committee of the American Nurses Association, in New York last January, said that nurses would face a problem of "fantastic proportions" in case of chemical attack against the United States.

Treatment of a nerve gas victim, he explained, is similar to that given a heavily anesthetized surgical patient, or person suffering from a sleeping pill overdose.

Dr. Joffe stressed that nurses must understand how to tell how much lethal gas the patient has taken in, and to determine the amount of medication required. Familiarity with modern techniques for artificial respiration will also be essential, he said.

He said that attack by incapacitating agents would present different problems, but, while effects are usually temporary and little or no medication is required, nurses would have to cope with "numbers of patients either unable to move or uncoordinated, or even irrational."

Mustard gas, introduced in World War I and still considered a potent weapon, can produce casualties which require up to five weeks nursing care, according to Dr. Joffe.

COL. WALTER J. UNGETHUEM

Colonel Walter J. Ungethuem, USA, retired, 64, who for some years had been Civil Defense director of Abington, Massachusetts, where he resided, died there on March 5, 1960. The burial was at Westfield, Mass.

Colonel Ungethuem, long an officer of the Chemical Corps, was awarded the Legion of Merit in World War II for his outstanding services at Edgewood Arsenal, Md., in charge of war plants design work. He also served in several key positions during World War II, until his retirement for disability, after 27 years of service. These positions included chief of the Engineering Division at Huntsville Arsenal, Alabama, and chief of Operations at Rocky Mountain Arsenal, Denver, Colorado.

A graduate of the University of Connecticut (1917), Colonel Ungethuem also held a Master's degree in business administration from Harvard. He is survived by his wife, Mrs. Mabel A. Ungethuem; a daughter, Miss Alice A. Ungethuem; a brother, Elsworth of Milwaukee, and two sisters residing in Massachusetts.

RADIOLOGICAL CONFERENCE

Lieut. General Edward J. O'Neill, Commanding General of The First US Army, welcomed 71 members of the Army National Guard and the Army Reserve to a special conference on Radiological Center Operations at Governors Island on March 5. The conference, the first of its kind, provided a thirteen-hour course on the various ways to combat the effects of a nuclear explosion, both the initial impact and the radiation that follows.

COL. MOORE JOINS BALCONES LABORATORY OF UNIV. OF TEXAS

Colonel Leslie S. Moore, chemical engineer, former deputy commander of the U.S. Army Biological Warfare Laboratories, Fort Detrick, Md., who retired from the Army last year, has been employed by the Balcones Research Center of the University of Texas, Austin, as Executive Assistant. Colonel Moore will edit the University's Engineering Science News.

CWS HISTORY ON SALE BY A.F.C.A.

Arrangements have been made with the Government Printing Office whereby the volume of the Army official histories, "U.S. Army in World War II, The Technical Services, The Chemical Warfare Service: Organizing For War," by Dr. Leo P. Brophy and Col. George J. B. Fisher, may be procured through the Armed Forces Chemical Association. The price of this volume is $4.00.

Orders placed with the Association will be handled without delay. They should be directed to:

The Secretary-Treasurer
Armed Forces Chemical Association
Suite 408 Park Lane Building
205 Eye Street, N.W.
Washington 6, D.C.

All checks should be made payable to the Armed Forces Chemical Association.

O. E. ROBERTS, JR.
Secretary-Treasurer

GROUP AND SUSTAINING MEMBERS

OF THE ARMED FORCES CHEMICAL ASSOCIATION

Abbott Laboratories, North Chicago, Ill.
Adache Associates, Inc., Engineers, Cleveland, Ohio
Air Reduction Company, Inc., New York, N.Y.
Allied Chemical Corporation, New York, N.Y.
American Cyanamid Company, New York, N.Y.
American Potash & Chemical Corporation, 300 West Sixth, St., Los Angeles 54, California
American Zinc, Lead & Smelting Co., St. Louis, Mo.
Armour & Company, Chicago, Ill.
Armstrong Cork Company, Lancaster, Pa.
Astra Pharmaceutical Products, Inc., Worcester 6, Mass
Atlas Powder Company, Wilmington, Del.
Avco Corporation, 750 Third Ave., New York 17, N.Y.
Barnebey-Cheney Company, Columbus, Ohio
Bechtel Corporation, San Francisco, Calif.
Blaw-Knox Company, Pittsburgh, Pa.
Brothers Chemical Company, 575 Forest St., Orange, N.J.
Brown Company, Berlin, N.H.
Casco Products Corporation, Bridgeport, Conn.
Celanese Corporation of America, New York, N.Y.
City Chemical Corp., New York, N.Y.
Columbia-Southern Chemical Corp., Pittsburgh, Pa.
Commercial Solvents Corporation, New York 16, N.Y.
Continental Oil Co., Ponca City, Okla.
Crane Co., Chicago, Ill.
Diamond Alkali Company, Cleveland, Ohio
Dow Chemical Company, Midland, Mich.
E. I. duPont de Nemours & Co., Inc., Wilmington, Del.
Edo Corporation, College Point, N.Y.
Engelhard Industries, Newark, N.J.
Esso Research and Engineering Co., Linden, N.J.
Evans Research & Development Corp., New York, N.Y.
Federal Laboratories, Inc., Saltsburg, Pa.
Ferguson, H. K., Company, The, Cleveland, Ohio
Ferro Corporation, Cleveland, Ohio
Firestone Industrial Products Co., Fall River, Mass.
Fisher Price Toys, Inc., East Aurora, N.Y.
Fisher Scientific Co., New York, N.Y.
Fluor Corporation, Ltd., The, Whittier, Calif.
Food Machinery & Chemical Corporation, New York, N.Y.
Foster Wheeler Corporation, New York, N.Y.
Fraser & Johnston Co., San Francisco, Calif.
General Aniline & Film Corporation, New York, N.Y.
General Electric Company, Chemical & Metallurgical Division, Pittsfield, Mass.
General Tire & Rubber Company, The, Wabash, Ind.
Goodrich, B. F., Chemical Company, Cleveland, Ohio
Harshaw Chemical Company, The, Cleveland, Ohio
Harvey Aluminum, Torrance, Calif.
Hercules Powder Company, Wilmington, Del.
Heyden Newport Chemical Corporation, New York, N.Y.
Hooker Chemical Corporation, Niagara Falls, N.Y.
Industrial Rubber Goods Company, St. Joseph, Mich.
International Nickel Co., Inc., New York, N.Y.
International Salt Co., Inc., Scranton, Pa.
Kennecott Copper Corporation, New York, N.Y.
Koppers Company, Inc., Pittsburgh, Pa.
Lambert-Hudnut Mfg., Laboratories, Inc., Lititz, Penna. subsidiary of Warner-Lambert Pharmaceutical Company, St. Louis, Mo.
Eli Lilly and Co., Indianapolis 6, Ind.
Little, Arthur D., Inc., Cambridge, Mass.
Lummus Company, The, 385 Madison Ave., New York, 17, N.Y.
Mason, L. E., Company, Hyde Park, Mass.
Merck & Company, Inc., Rahway, N.J.
Mine Safety Appliances Co., Pittsburgh, Pa.
Minnesota Mining & Manufacturing Co., 900 Fauquier Avenue, St. Paul, Minnesota
Miracle Adhesives, Corp., 250 Pettit Ave., Bellmore, Long Island.
Monsanto Chemical Company, St. Louis, Mo.
National Lead Co., 111 Broadway, New York 6, N.Y.
Niagara Blower Co., New York, N.Y.
Olin Mathieson Chemical Corp., East Alton, Ill.
Oronite Chemical Company, San Francisco, Calif.
Pemco Corporation, Baltimore, Md.
Pennsalt Chemicals Corporation, Philadelphia, Pa.
Pfizer, Chas. & Company, Inc., Brooklyn, N.Y.
Pfaudler Company, a Division of Pfaudler Permutit, Inc., Rochester 3, New York
Phillips Petroleum Company, Bartlesville, Okla.
Pittsburgh Chemical Co., Pittsburgh, Pa.
Procter & Gamble, Cincinnati, Ohio.
Reynolds Metals Company, Louisville 1, Ky.
Shell Chemical Corp., Denver, Colo.
Shell Development Company, Emeryville, Calif.
Sheller Mfg. Co., Dryden Rubber Div., Chicago, Ill.
Shwayder Bros., Inc., Denver, Colo.
Standard Oil Company (Indiana), Chicago, Ill.
Stauffer Chemical Company, New York, N.Y.
Sun Oil Company, Philadelphia, Pa.
Union Carbide Corporation, New York, N.Y.
United-Carr Fastener Corp., Cambridge, Mass.
Universal Match Corp., Ferguson, Mo.
United States Borax & Chemical Corp., 630 Shatto Place, Los Angeles 5, Calif.
Vitro Corporation of America, New York, N.Y.
Vulcan-Cincinnati, Inc., 120 Sycamore St., Cincinnati 2, Ohio
Wigton-Abbott Corporation, 1225 South Avenue, Plainfield, N.J.
Witco Chemical Company, Chicago, Ill.
Wyandotte Chemicals Corp., Wyandotte, Mich.

Companies listed in bold face type are Sustaining Members

WITH THE CHEMICAL CORPS

Brigadier General Jae Myung Kim, Chief Chemical Officer of the Republic of Korea Army, presents plaque to Major General Marshall Stubbs, US Army Chief Chemical Officer at dinner at Army Chemical Center in honor of General Kim and other visiting Korean officers, on 11 February 1960.

CHIEF CHEMICAL OFFICERS—U.S.A. AND KOREA

A three-day orientation tour of Army Chemical Center facilities was concluded on February 12 by five top-ranking Republic of Korea Army officers.

The Korean Army visitors were: Brig. General Jae Myung Kim, Chief Chemical Officer of the Korean Army, Colonels Dong Chun Cha and Jae Kun Han, and Lt. Colonels Jung Ho Moon and Soo Dong Kim.

Sponsored by the U.S. Military Assistance Program, they are scheduled for similar visits to other Chemical Corps installations.

CHEMICAL CORPS RAD TEAMS TAKE PART IN THIRD ARMY EXERCISE

FORT McCLELLAN, ALABAMA—Ten Radiological Center teams from Chemical Corps Training Command participated in the 24 hour operation, Exercise Lucky Echo, held recently at Fort Gordon, Georgia.

The annual "Lucky" operation is a Third Army training exercise designed especially to give field experience in the new pentomic Army concepts to National Guard and Army reserve units in the Third Army area.

The personnel for these four-man Rad teams were from the Chemical Corps Radiological Unit and 83rd Chemical Battalion of the 100th Chemical Group.

The battle area for the exercise was in a "hostile country," and the teams were assigned to augment divisions to predict nuclear fallout if nuclear warfare was introduced.

Lieutenant Charles H. Ellis, Jr., group leader for the personnel sent from Training Command, reported that "all teams did an exceptionally good job" and that "intra-service cooperation was superb."

LONDON FELLOWSHIP TO STUDY INCREASE IN MALARIA DEATHS

ARMY CHEMICAL CENTER, Md.—Dr. Herbert Lipke, a Baltimore resident who is a Chemical Warfare Laboratories insect biochemist, has been granted a United Nations World Health Organization research fellowship to tackle the problem of an upsurge in malaria deaths.

The increase has been attributed at least in part to malaria-carrying mosquitoes' tendency to build up resistance to insecticides.

Dr. Lipke's research will be carried on at the University of London's Ross Institute. He and his family will leave for Europe in August, and he will tour research centers and U.S. military installations in England and on the Continent before beginning work in October.

Dr. Lipke made extensive studies on insect resistance to insecticides while at the University of Illinois, where he received his doctorate in entomology.

COMMENDATION RIBBON

Major Malvin F. Glass, Jr., Office of the Inspector General, Army Chemical Center, Md., was recently decorated with the Army Commendation Ribbon with Metal Pendant, by the Chief Chemical Officer, Major General Marshall Stubbs, at a ceremony held in General Stubbs' office, Washington, D.C.

SERGEANT MAJOR IN HAWAII

The picture above shows Colonel Carl V. Burke, Chemical Officer, U.S. Army, Pacific, congratulating Sergeant Major Salvador Contreras on his recent promotion to that grade.

Sergeant Major Contreras is the Senior Chemical noncommissioned officer of the Chemical Office, Headquarters, USARPAC, Hawaii, and is the first Chemical Corps non-commissioned officer to be appointed to this grade in the Pacific theater. He is a veteran of 19 years service of which 17 have been spent with the Chemical Corps. His assignments have included the basic training unit at Edgewood Arsenal, Maryland; Chemical units in CONUS and the European theater, and, during the Korean conflict, the 71st Cml Co Smoke Generator.

SIMPLIFIED GAS DETECTOR

FORT MONROE, VA.—The Army's Chief Chemical Officer, Major General Marshall Stubbs (left) and Colonel Robert W. Breaks (right), Chief Chemical Officer for Headquarters, U.S. Continental Army Command, Fort Monroe, examine a simplified chemical warfare detector kit which will detect all known war gases. General Stubbs visited CONARC during February for conferences and briefings.

ACC STRAC INTELLIGENCE UNIT IN AIRLIFT EXERCISE

The Army Chemical Center's 17th Chemical Detachment (Technical Intelligence) was listed to participate in a two-week joint Army-Air Force training exercise involving airlift to Puerto Rico and return conducted by the Strategic Army Corps (STRAC) and Military Air Transport Service (MATS) in March.

The Chemical Detachment is the only STRAC unit located at the Center.

The exercise, known as BIG SLAM/PUERTO PINE, provided for the deployment of some 18,000 Army troops and 12,000 tons of Army equipment.

Commanded by Major Robert F. Nastre, the Chemical STRAC unit was charged with the mission of performing battlefield analyses and evaluations of captured enemy equipment. An operational team, headed by Captain Conrad Duncan, planned to depart by air from Dover (Del.) Air Force Base.

The exercise consisted of three phases; deployment to Puerto Rico, preparations for forward displacement, and the return to the United States. The Army action was to provide a test of the air mobility of STRAC and its ability to go directly into operation after landing.

50th CHEMICAL PLATOON AIDS IN DESERT EXERCISE

FORT ORD, CALIF.—Officers and men of the 50th Chemical Platoon (Combat Support), 2d Logistical Command, left here during the week of February 19 by motor convoy for Camp Irwin, Calif., to provide chemical support for armored units in the desert train-

ing exercise "Mesquite Dune," scheduled for the first part of March. The unit planned to return to Fort Ord on March 19.

TO STUDY MILITARY LAW

BACK TO SCHOOL—Four "old soldiers" whose total active Army service runs to more than 60 years recently joined the Army Chemical Center's "back to school" campaign when they signed up for a University of Maryland evening course in Military Law. Major Philip B. Polak (left) post Judge Advocate, teaches the course, meeting in the post classroom each Wednes-

day evening. The soldier-students above are (left to right): M/Sgt. Frank Ter Linden, Sgt. Major Robert A. Bruce, M/Sgt. Charlie W. Booth, and M/Sgt. William D. Welch. At far right is SFC Gustav J. Siedler, assistant post Education Advisor, who signed the old-timers up in the recent post-wide "back to school" drive.

DR. ELAM HONORED FOR RESUSCITATION STUDIES

A Certificate of Achievement was awarded to Dr. James O. Elam in ceremonies at Army Chemical Center last February in official Army recognition of his outstanding contributions to resuscitation and life-saving methods.

Brigadier General Graydon C. Essman, post commander, made the presentation.

Dr. Elam, who formerly served in Medical Research at the Chemical Center, is currently the director of the Department of Anesthesiology, Roswell Park Memorial Institute, Buffalo, New York. He pioneered much of the early work on the now nationally adopted "mouth-to-mouth" resuscitation method of life-saving. He is also credited with early research work, using this same principle, which ultimately led to the development of a "mask-to-mask" device for resuscitation of nerve gas casualties in contaminated atmospheres.

A 1945 graduate of The Johns Hopkins School of Medicine, Dr. Elam was assistant professor of anesthesiology at Washington University before being called to active Army duty as a Medical Corps officer in 1954.

COLONEL SPENCER IS RETIRED

Lieutenant Colonel Allen W. Spencer, Chemical Corps, Post Inspector, Pine Bluff Arsenal, Arkansas, retired on January 31, 1960 after more than 20 years active service.

Colonel Spencer was first commissioned in the Infantry Reserve upon graduation from the University of Florida, June 6, 1932. He entered upon active duty with the Civilian Conservation Corps, June 30, 1937, and his current tour of active duty dates from May 21, 1942.

Colonel and Mrs. Spencer plan to visit at Sarasota, Florida, before making further plans.

COL. ALTON K. SMITH RETIRED

Lt. Colonel Alton K. Smith, of the Chemical Corps, was retired with appropriate ceremonies on 29 January 1960 at Fitzsimmons Army Hospital, Denver, Colorado, which he had entered shortly before as a patient.

Colonel Smith entered the military service as an enlisted man in the Army Air Corps in 1939, attended Officer Candidate School of the Chemical Corps, and was commissioned 2d Lieutenant in 1942. During World War II he served until September 1945 as Commander of the 711th Chemical Maintenance Company in the European Theatre of Operations.

His career after the war included duty as Procurement Officer in New York, Executive Officer at the Deseret Chemical Depot, Tooele, Utah, and other assignments at Army Chemical Center, San Jose Project, Virgin Islands, and Fort McClellan and Rocky Mountain Arsenal, Colorado. He was serving as Property Officer and Post Inspector at the Rocky Mountain Arsenal when he entered the hospital.

Colonel Smith has been awarded the Purple Heart, the Army Commendation Ribbon, the Bronze Star Medal, and the French Croix de Guerre. He plans to reside permanently in the Denver area.

EAGLES FOR COL. DeCARLO

Lt. Colonel Michael R. DeCarlo, Assistant to the Deputy Chief Chemical Officer for Scientific Activities, was promoted last February to the grade of Colonel. He also was recently awarded the Army Commendation Ribbon with Metal Pendant.

AWARDS

OFFICE CHIEF CHEMICAL OFFICER, WASHINGTON, D.C.

Outstanding Performance Rating:

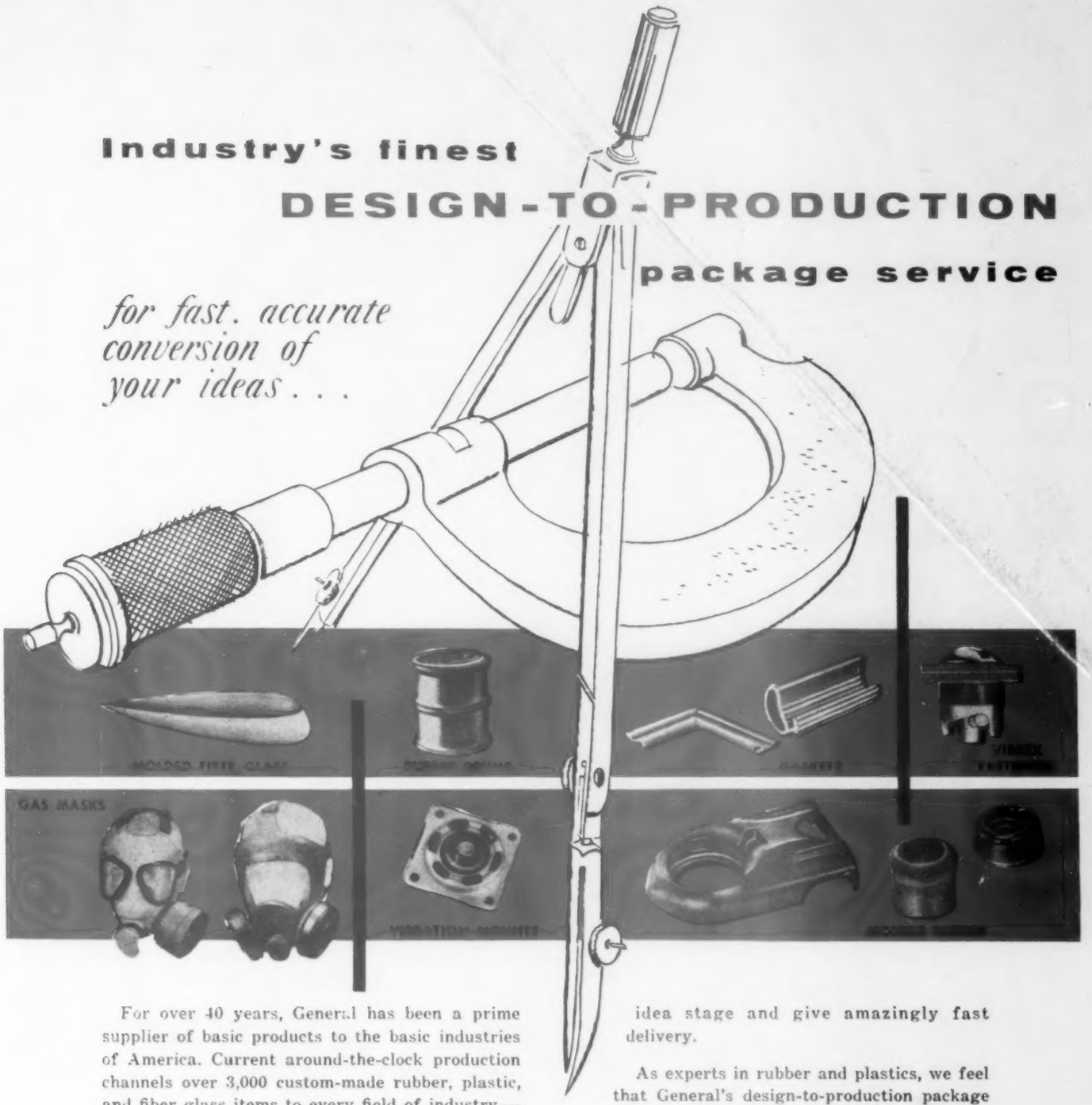
Bernice S. Kitchen,	Personnel Division
Charles W. Lombard,	Office of the Comptroller
Seymour Waxman,	Office of the Assistant Chief Chemical Officer for Planning and Doctrine

Sustained Superior Performance:

Denis C. Worley,	Office of the Comptroller

Industry's finest DESIGN-TO-PRODUCTION package service

for fast, accurate conversion of your ideas . . .



For over 40 years, General has been a prime supplier of basic products to the basic industries of America. Current around-the-clock production channels over 3,000 custom-made rubber, plastic, and fiber glass items to every field of industry — automotive, aircraft, petroleum, household and electrical appliances, communications, textile, heavy machinery, and the military.

The backbone of this vast operation is an unusually large staff of engineers, designers, researchers, and development men. Working with the finest mechanical facilities in the business, these specialists can take your product in the idea stage and give amazingly fast delivery.

As experts in rubber and plastics, we feel that General's design-to-production package is the best possible combination of talent and ability-to-produce.

- Extruded Rubber
- Molded Rubber
- Latex Foam
- Urethane Foam
- Extruded Plastic
- Polyester Glass Laminates
- Silentbloc Machinery Mounts
- Silentbloc Bushings, Bearings
- Silentbloc Instrument Mounts
- Vibrex Fasteners
- Glass-Run Channel
- Rubber-to-Metal Bonding
- Rubber-Metal Assemblies
- Oil and Hydraulic Seals
- Hydraulic Brake Parts
- Lathe-Cut Parts
- Die-Cut Parts
- Metal Stampings
- Molds, Dies, Tools, Jigs
- Custom Metal Fabrication

Industrial Products Division GENERAL THE GENERAL TIRE & RUBBER CO.

***For additional information on General's diversified products and services, write to:* The General Tire & Rubber Company, Industrial Products Division, Wabash, Indiana.**

GENERAL TIRE & RUBBER CO.

Industrial Products Division • WABASH, IND.

essential chemicals for all industries

chlorine
caustic soda
soda ash
sodium bicarbonate
caustic potash
solvents
ammonia
chrome chemicals
barium chemicals
sulfur chemicals
agricultural chemicals
reinforcing pigments
calcium chloride
muriatic acid
calcium hyporchlorite
hydrogen peroxide
titanium tetrachloride

columbia | southern chemicals

COLUMBIA-SOUTHERN CHEMICAL CORPORATION
A Subsidiary of Pittsburgh Plate Glass Company
One Gateway Center, Pittsburgh 22, Pennsylvania